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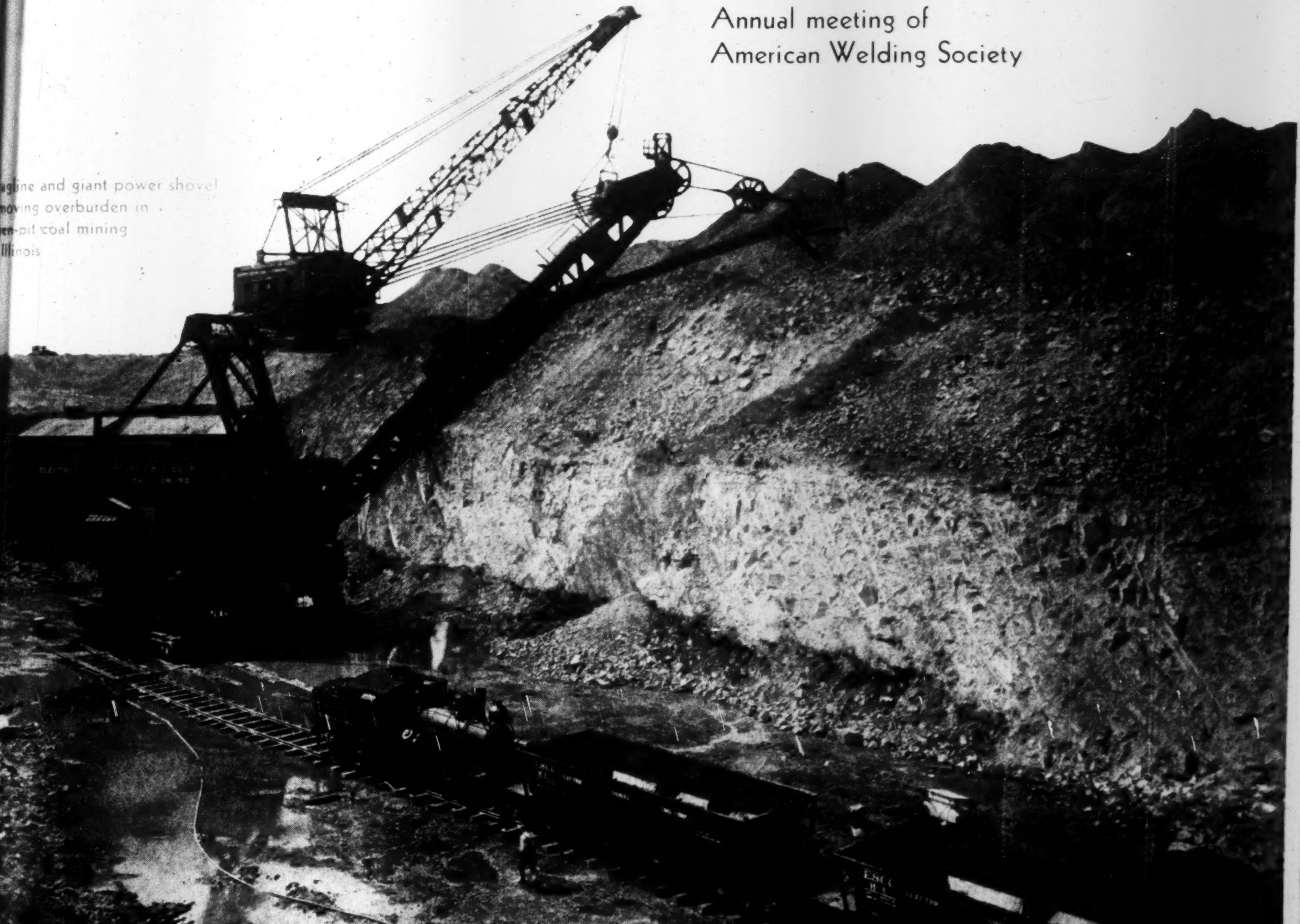
Earthmoving as practiced in coal-mine stripping . . . and

Siphon spillways on Tiger Creek conduit in California

Underpinning elevated railroads over New York subways

Architects discuss housing at Washington meeting

Annual meeting of American Welding Society



agline and giant power shovel
moving overburden in
en-pit coal mining
Illinois

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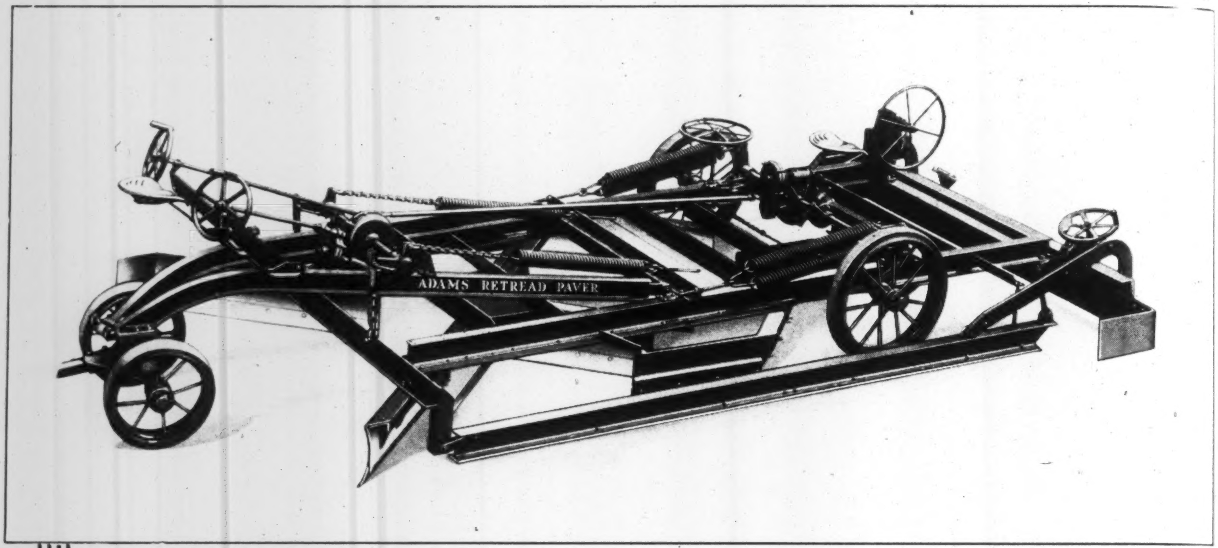

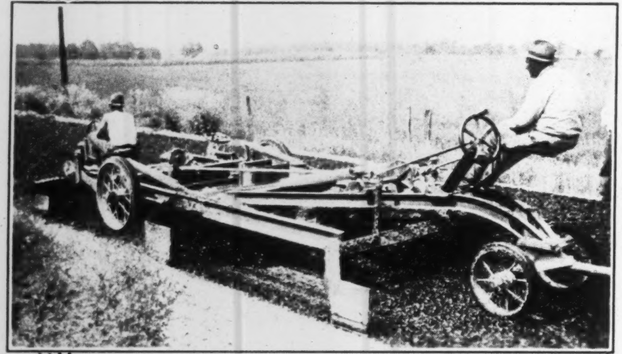

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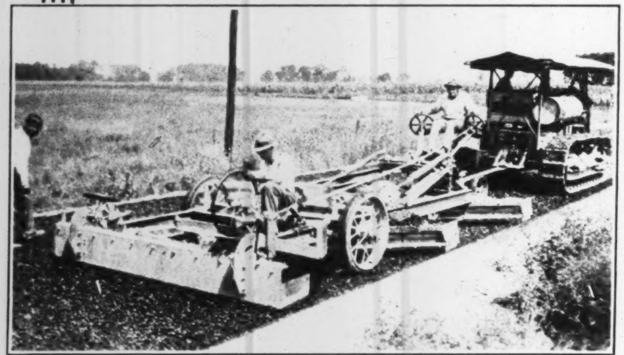

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Engineering News-Record

Established 1874 ✦ A Weekly Journal of Civil Engineering and Construction Practice ✦ McGraw-Hill Publishing Company, Inc.

F. E. Schmitt, Editor

Volume 108 New York, May 5, 1932 Number 18

Hardboiled Hats

REPORTS from Hoover Dam credit a stiff fiber or "hardboiled" hat with saving the life of a workman who was struck by a falling timber. The contractor's insistence that every man working in the canyon or tunnels be equipped with a safety hat was well paid for by this one incident. But the saving is beyond estimate in dollars. The contractor's satisfaction in returning that man to his family alive and well instead of in a coffin cannot be measured in money. On a job presenting most unusual hazards, Six Companies is demonstrating that accidents can be prevented and that safety measures pay big dividends.

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Less Work

AS YET no progress is visible toward passage of the emergency road loan bill. Without it a large reduction in road construction and therefore in employment in many parts of the Union is certain. The issue is especially critical because everyone's efforts are centered on the problem of how to build up employment so that the worker can again take his place in the normal life of the nation. These efforts will be heavily handicapped if road construction is curtailed. Already gasoline-tax diversions and reductions in state appropriations have reduced the program seriously; if federal-aid work is to be affected in the same way by withholding the credit grant to the states the case will be much worse. Last year, under conditions far less threatening than those of today, the President and Congress agreed on the need of such aid, but this year the President is opposed and the Senate has shelved the emergency loan bill passed by the House. Since it is unmistakably plain that this year's need for maintaining employment exceeds the need of 1931, every effort is warranted to help the early passage of the bill. Whatever engineers can do to speed it along is worth doing at once.

Checking Bid Shopping

SUBCONTRACTORS in New Orleans have an effective scheme for the elimination of bid shopping on the part of general contractors. A day or so before general bids are to be opened, the proposals of all subcontractors asked to submit bids are opened in the offices of the subcontractors' association, both members and non-members of the group participating; owner, architect, engineer and general contractor are invited to be present at the opening. This procedure restrains general contractors from misrepresenting a low bid to other firms in an attempt to secure lower prices, though it is fully effective only if all subcontractors refrain from secretly offering lower bids than their announced figure. General adoption of the system used in New Orleans would eliminate the necessity of burdening contracting with regulatory laws—such as the Bingham-Goss bill now before Congress—in matters that should be controlled by the industry's practice.

Back to the Land

THE back-to-the-land movement is to be put to a practical test of usefulness by engineers in Cleveland. Unemployed members of the engineering profession are to be provided with an acre of land and shelter, if necessary, on a 1,200-acre piece of property on the outskirts of the city. Working in groups under direction of an experienced agriculturist, they will cultivate truck gardens, raising crops for their own use or for barter. A commissary is to be set up to feed the men, to supply tools and other necessities and to dispose of the farm products. Engineering services in running lines or laying out drainage system for neighboring farmers also will be undertaken. The movement would be worth while if it did nothing more than take unemployed men off the city streets and put them out in the sun and air, where they can at least build up their physical strength. But it adds the moral stimulus of productive work and of tackling a new job. For some who have worked the land in the past it may reawaken an appreciation of farming as an occupation; others, heretofore unfamilar with the land, may be attracted to it. A temporary emergency movement may thus develop into a permanent move back to the land.

Is Wisdom an Asset?

TUCKED away in a corner of the expense-reduction measures now being worked on by Congress is a provision for compulsory retirement of all government officials who have reached the age limit. Heretofore such men could be retained if their service was found of special value to the country; the new bill proposes to abolish discretion, and to retire them regardless of the value of their service. It discards arbitrarily those special assets of wisdom that age brings to able men. In New Orleans, for example, the noted flood forecaster of the Mississippi, Dr. Cline, is to be taken from his work; the people living along the river under constant threat of its waters will have to do without his detailed and precise warnings. In Washington the experienced master of the Reclamation Bureau, Dr. Elwood Mead, is to be put on the shelf, and the intricate maze of problems with which he deals is to be deprived of the wisdom he has gathered in a half-century of irrigation activities. Such consequences of the bill tempt one to ask whether Congress believes that wisdom is an asset worth saving for the country's further service.

Symposiums Made Useful

SYMPOSIUM sessions at society meetings seldom justify the trouble it takes to arrange them. This is to be regretted, for the basic plan of a symposium—the focusing of individual and diverse opinions on a single, vital, live question—is essential to all progress. The fault lies not in the idea itself but in its execution. To take a current example: A typical symposium formed a part of the American Welding Society program last week, and ten or a dozen papers on weld ductility were read. All were good papers, but at the end of the session the audience had been bombarded with so many opinions and data that the average listener did not know who was for and who was against ductility, much less what the significance of the meeting might be to himself. Obviously, a summation and a review of the data presented were badly needed. Fortunately for the audience and incidentally for the program makers, J. H. Critchett, vice-president, Union Carbide & Carbon Research Laboratories, voluntarily chose to supply the needed review and a critical analysis. A session that had dropped to the level of dull recitation was converted thus simply into the most stimulating, thought-provoking one of the entire meeting. A lawyer would never consider permitting a jury to retire without summing up for it the many points of evidence that had been presented. Why should program committees do less for their audiences? Every symposium that is worth organizing is worth summarizing by an able review.

Ductility Debate

DUCTILITY has suddenly emerged as something of an issue in welding circles as a result of a new pressure vessel code in which weld ductility equal to that of the parent metal is set up as the criterion of good welding. Discussion of the subject at the meeting of the American Welding Society last week brought out the wide range of opinion that prevails, for there was little agreement on definite ductility values, although a majority of those present believed that extreme ductility is unnecessary. Those interested in structural welding are perhaps least concerned with the property of weld ductility, for most of the structural welds in this country are of low ductility, having been made with bare wire electrodes, and yet are entirely satisfactory in their performance. When welding is extended to structures in which variable stress and impact are vital factors, perhaps some added ductility may be required. However, the field of structural welding might well leave the ductility debate to others and give some consideration to the weld metal property designated by Prof. H. F. Moore as crackless plasticity, defined as the ability to resist spreading cracks under repeated and impact stresses. The pores present in the best of present-day weld metals form points of high localized stress from which cracks may spread under such loadings. Greater homogeneity rather than ductility would seem to be the primary concern of engineers who are contemplating using welding to carry impact loads.

Professional Conscience

"WE ARE passing through a time of unrest," said Robert D. Kohn last week in his presidential address to the American Institute of Architects, "when it is essential that we examine into the validity of those purposes which we have sought to attain, assure ourselves that they are still worth while working for in our own day and generation, measure the extent to which we have made progress in the past, and, most important of all, find out where we have failed to do so. Only through such a process can our profession develop to the full that initiative and leadership in its particular function which the public has a right to expect of us." These words of admonition address themselves quite as much to the engineering as to the architectural profession. The appraisal which Mr. Kohn counsels may be more difficult for engineers, whose field of labor has seen profound transformations within the past few decades, but this very fact makes the self-examination supremely important. Unless the profession of civil engineering can in good conscience reaffirm its old-time aims or else reshape them to modern needs, unless it can show progress toward their realization and verify its present course, its authority and initiative are in danger.

Waste in Economy

WHEN Congress cut the Hoover Dam appropriation in the Interior Department bill to six million dollars it put on the books a nominal economy. Actually this "economy" represents a tragic waste, which everyone should know and understand. The facts in brief are these:

Of the funds so far appropriated for the great enterprise of controlling the Colorado River ($31,000,000) all but two million dollars has been used, two-thirds by the contractor for construction operations and one-third by the government in buying materials and supervising the work. The balance, supplemented by the six millions just appropriated, provides a total of eight millions to cover more than a year's work. In that time the greatest task of the whole undertaking, diverting the river and excavating the bottom to a secure foundation, is to be accomplished. The diversion tunnels and their lining must be completed first; in October the construction of a temporary diversion dam is to begin, followed immediately by construction of the two main cofferdams, and when these are completed in January the pit between is to be pumped out and the six-month job of clearing the dam foundation is to begin. Speed is the dominating requirement at this critical stage of the work, as everyone knows. Flood seasons determine the time schedule, for if the stream is not diverted before the next high water season a year's time will be lost.

At their present rate the construction operations are consuming about two million dollars per month. During the first four months of 1932 the contractor expended 8½ millions, though retarded by high water, and a similar rate of working must be maintained until the cofferdams are completed if the diversion is to be accomplished by the next flood season. But if the total money available is only eight millions he can continue working only four or five months at best, and will have to shut down his plant in early fall and let his thousands of employees in Boulder City drift home as best they may. The government's model city in the sagebrush will become a deserted village.

The "economy" of the current appropriation thus makes a year's loss of time inevitable. Removal of the menace of the uncontrolled Colorado will be postponed, the dominating construction activity of the entire Southwest will be paralyzed, and dependent plans and undertakings of even greater magnitude will be jeopardized. Quite aside from these losses, however, the direct money cost of the delay will exceed the temporary paper saving. Interest on the money already spent, increased by the loss in shutting down Boulder City and the construction plant, to say nothing of consequential losses and damages, mounts up to a total of millions.

Discontinuing a self-supporting improvement runs directly counter to the supreme need of the day. We may sympathize with all efforts to reduce the running expense of government, but no one can approve of discontinuance of productive enterprise in times like the present. Hoover Dam is precisely that. It will begin earning a return as soon as the plant is completed, and in due time will return to the government its full cost.

Possibly the present Congress hoped that its successor would supplement the present appropriation by a deficiency appropriation next December. This is in the lap of the gods, however, for what the next Congress may do cannot be forecast. In any event the figures given make it apparent that under the present appropriation the work will come to an end long before that Congress meets. Waste of time and money is inevitable, therefore, unless the present Congress before ending its session recognizes its error and provides an adequate supplementary appropriation so that work will not have to be closed down.

Indispensable to Construction

SHORTLY after its organization barely three years ago the Bureau of Contract Information undertook the experiment of supplying verified impartial information concerning past performance and the integrity of contractors to buyers of construction. Because this service filled a need in creating means for distinguishing between responsible and irresponsible contractors, the success of the experiment was never in doubt. The bureau has capably demonstrated the value of its services and has become recognized as a stabilizing influence in a much harassed industry. It is now known to be indispensable to the soundness and stability of contracting.

Today the data provided by the bureau have a wide acceptance among those responsible for the award of contracts. They are freely used by departments of the federal government, by state highway officials, by municipal authorities and by private interests throughout the country. Daily more than 100 reports on contractors are being sent out in response to requests from architects, engineers and public officials having contracts to award. While the bureau has ready information concerning some 6,000 contractors, who have voluntarily filed their performance and financial records, it is equipped to check up on other contractors upon request. One of the greatest safeguards to those letting contracts is the system of checking of further moves of individuals responsible for a default of a construction contract or connected with a firm's failure.

Responsible contractors, who are directly benefited by this central collection of information on responsible construction service, have a personal interest in supporting the new plan of financing the bureau, reported in our news pages this week. The surety companies who have financed the work to date can no longer be expected to carry the full burden of carrying the service. Since it benefits construction as a whole, the construction field should join wholeheartedly in its financial support. If it fails to do so the bureau may have to revert to its original status of a surety company agency alone.

That this would be a backward step is readily seen. Most particularly in times like the present, when intense competition prevails, it is essential to maintain every possible safeguard against unsound contracting practice. Responsible contractors need the Bureau of Contract Information and owe it their financial and moral support.

The Giant Excavator

MACHINE magnitude and volume of excavation have reached an amazing height of accomplishment in the coal-mine stripping operation described in this issue. Even among engineers it is probably not common knowledge that such sizes of earth-moving operations and such colossal equipment units are current. Indeed it is difficult to realize that a single coal-mining operation in Illinois involves waste excavation great enough to fill two Panama Canals. Even more difficult is it to accept the fact that compared with the 1,750-ton 20-yd. electric shovel of the Illinois mine the giant among steam shovels on the Panama Canal weighed 95 tons and had a 5-yd. dipper. Yet these are the facts.

The significant point of the great Illinois shovel is that it is not an abnormality but a normal growth from the 690-ton and 925-ton shovels which preceded. Other shovels as large or larger are being built for other stripmining undertakings. Though logically evolved, the great stripping shovel is admittedly a machine for special requirements in earth handling. But its restriction to mine stripping is not necessarily definitive. Large canal construction offers an entirely practicable field for a machine as large and heavy, due to the easy mobility it gains by modern crawler traction. A machine that has a dumping height of 80 ft. and a dumping radius of 150 ft. is well suited for canal spoil disposal.

Irrespective of its extension to other uses the large power shovel has become supreme in America as a minestripping tool. Its only close competitor is the dragline excavator; some even contend that the modern dragline with 175- to 200-ft. boom and mobile traction claims precedence. Considering their exclusive use in this country it is strange that the shovel and dragline have gained no considerable favor in European strip mining. Abroad, and particularly in German lignite mining, the traveling tower occupies a similarly exclusive position. Attempts to promote the use of the German machines in America have been as fruitless as attempts to introduce the shovel and dragline into Europe. Regardless of reason or habit or perhaps prejudice as accounting for difference in practice, the mine-stripping equipment of Europe and America presents a notable extension of the equipment engineer's art to the development of size and capacity in construction equipment.

Coal-Mine Stripping Practice With Giant Power Shovels

Methods and equipment for moving large yardages of overburden at costs invariably under ten cents a cubic yard

By A. T. Shurick and F. E. Toenniges
Consulting Engineer and Chief Engineer, Respectively, United Electric Coal Companies, New York, N. Y., and Danville, Ill.

❖

THE STRIP-MINING of coal on a commercial scale in the United States dates back 70 years and perhaps to earlier days. Evidences remain in the Pennsylvania anthracite fields of old wheelbarrow runs for removing overburden when a pick and shovel were the excavating tools. In a few years the advance was made to drag scrapers and then to wheel scrapers. In 1866 strip-mining began in the Danville district, Illinois, using plows and scrapers. Power equipment for removing overburden was first used about 1877 in the Pittsburg district, Kansas. An Otis steam shovel was employed, but its use was limited to an overburden depth of 10 or 12 ft. In 1885 a dipper dredge mounted on rollers was installed in the Danville district and was followed by two similar stripping machines, the largest having a 1½-yd. dipper and a 65-ft. boom. In 1890 dragline excavators were introduced in the same district; the largest had a 1-yd. bucket. Other draglines, successively improved, were put in service in 1900 and 1903 in both the Illinois and Kansas fields. Meanwhile, in 1893-1906, steam shovels had come into use for stripping iron and copper ore. In 1907 in Kentucky a railroad-type steam shovel with a 2½-yd. dipper and a 28-ft. boom was put to work on a 6- to 12-ft. stripping operation. In 1910 larger shovels with 1½-yd. dippers were put to work in the Kansas fields. The development of steam shovels for the Panama Canal work, 1904-1914, had established the steam shovel as an efficient, versatile, low-cost excavator and loader. There followed in 1911 the bold undertaking of a specially built stripping shovel for the Illinois field with a 3½-yd. dipper, an 85-ft. boom and a 40-ft. dipper handle and weighing 150 tons. This was the first full-revolving type machine, which marked the beginning of the development of giant shovels for strip-mining coal, culminating in the 1,750-ton machine of today. In the following article the volume, economics, costs, methods and equipment characteristic of overburden removal in open-pit coal mining are analyzed by engineers versed by experience and study in current problems and practices. —EDITOR.

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IN THE LARGE coal-stripping operations of the mid-continent field the mining engineer has fallen heir to work that is more the exclusive prerogative of the civil engineer. The total excavation to be moved at the United Electric Coal Companies' new Du Quoin, Ill., operation alone, for example, is 447,000,000 cu.yd., or about twice the total dry and wet excavation in the Panama Canal. The excavation actually moved with ten shovels in 1931 was 12,900,000 cu.yd., but the equipment was operated at only 50 per cent capacity due to the adverse coal market. It seems possible that the methods developed might be applied to other large excavations.

These operations have become possible only through certain economic influences. The average ratio of coal to overburden in coal stripping is now 1 : 7½. This ratio, together with the marketing opportunities, is the principal factor in determining the economic possibilities of a coal-stripping project. An average market realization of $1.50 per ton for the coal does not ordinarily justify stripping an overburden ratio exceeding 1 : 6, while an average realization of $2.50 will make it possible to strip ratios up to 1 : 15, or higher in special cases. These factors assume average favorable stripping conditions. The minimum ratio mined on any important scale in this country is 1 : 1¾ at Colstrip, Mont. High and low ratios are the exception, the great bulk of the strip coal coming from mines with ratios of 1 : 6 to 1 : 11.

Ten-year statistics to 1929 reflect a remarkable advance in strip-mining technique. Production of strip coal increased 140 per cent in this period, while the number of power-equipped pits increased 21 per cent, the number of power shovels 48 per cent, men employed 34 per cent, and the tonnage per man per day 96 per cent. This shows the rapid trend toward large-capacity units and the much higher efficiency of the more powerful shovels now in service. These results have been achieved in the face of constantly increasing overburdens, the average ratio in 1928 having been estimated at 1 : 7½, as compared with 1 : 6 in 1914. The more desirable stripping reserves are now being exhausted at a rate that will make for a more rapid increase in the overburden from now until the economic limit of stripping is approached. The technical advantage of the strip operator over the deep miner is indicated in their respective production per man per day, which in 1929 was 4.8 tons at the deep mines and 14.1 tons at the strip mines.

Strip-pit layout

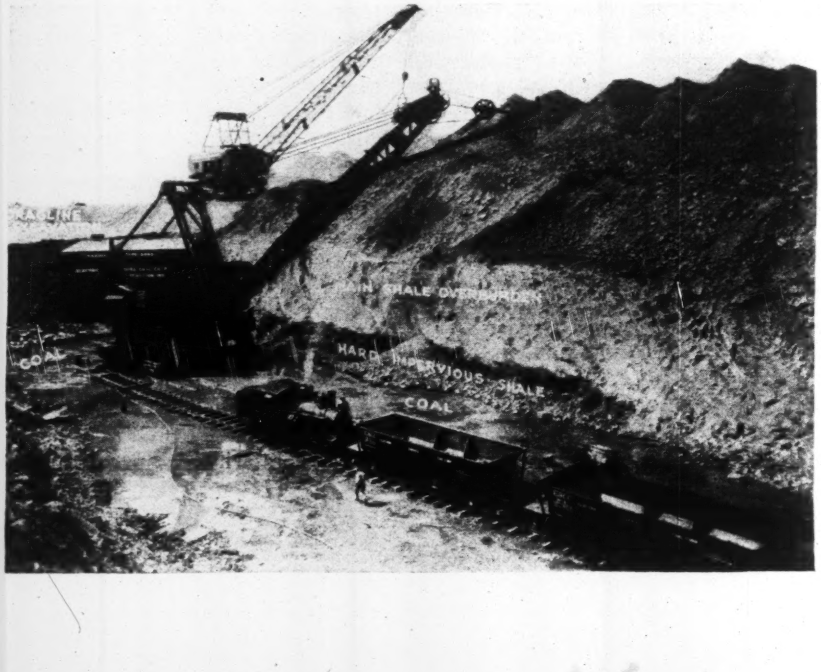
The great bulk of the stripper's work is a simple overcasting of the material. While this seems elementary, the proper layout of a modern large-scale stripping operation involves many technicalities.

Most of the controlling principles of a typical layout are developed in the accompanying air view, Fig. *2*. First, we have the mine tipple at *D*, over the railroad tracks. The mine track, from the pits to the tipple, backswitches and comes down to the pit-bottom level through the box cut, which apexes with the line to the tipple.

The strategic location of the opening box cut is perhaps one of the most important problems in the initial layout, for the reason that all subsequent operations pivot around this point, as shown in Figs. *2* and *4*. Other conditions being favorable, it is located about the center of one side of the property where there will be minimum haul and interference with coal extraction. The length of the cut varies with the thickness of overburden and pitch, the latter being fixed by the size of the coal trains to be hauled and the locomotive capacity, all predetermined before operations are started. It is desirable to get as long a cut as possible, and our maximum grade is limited to 1½ per cent.

The next important problem is fixing

Fig. 1—Two-unit stripping plant for opening up pioneer cut to coal seam.



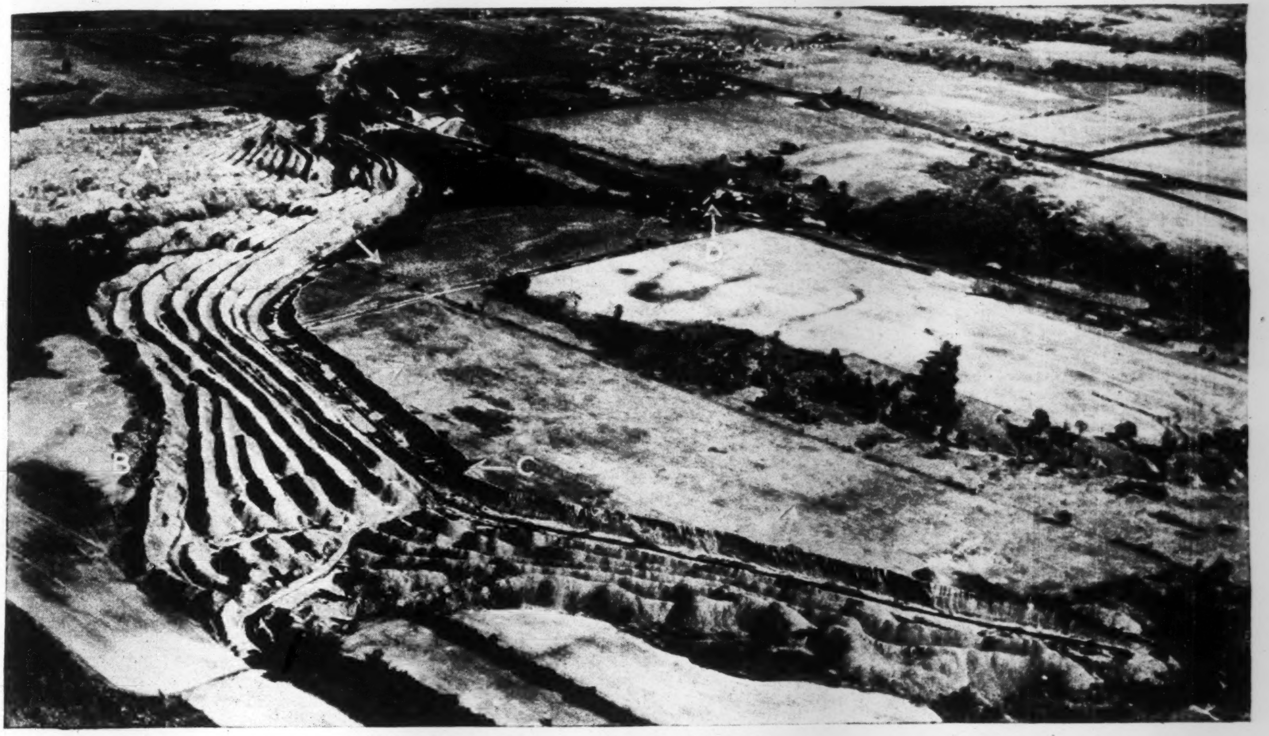


Fig. 2—Modern large-scale coal-stripping operation, showing main elements. Marked points are as follows: A, old workings; B, waste-cone ridge formed by overburden from opening box cut; C, face of present stripping; D, mine tipple.

the location of the initial box cut, or cuts, along the top of the coal. A number of factors are to be considered here, such as wastage of overburden, prevailing dip of the coal seam as affecting haulage and drainage, size and shape of the property, deficient coal areas and abnormal variations in the character or depth of overburden. Good judgment and experience are necessary to weigh the relative importance of these different factors under varying conditions, and this may mean the difference between success or failure of the project in commercial operation.

Economy in wastage of overburden is generally the most important factor, a faulty layout sometimes resulting in rehandling with a booster shovel, thus adding to the costs. The 6- or 7-ft. height gained at the base of the waste-cone section by the removal of the coal helps materially, but it does not compensate for the 20 per cent swelling in clay and 30 per cent in rock, together with the loss in the valleys between the cone ridges (Fig. 2). The ideal layout for maximum wastage is, of course, a true circle overcasting to the outside, which increases the wastage area in direct proportion to the longer circumference of the wasting circle, compared with the shorter excavating circle on the inside. This is not practicable in actual operations, but it is frequently possible to adopt modifications of this natural phenomenon, as shown in both units of Fig. 2. This may be a factor of the greatest importance in extra-heavy overburden.

The operation shown in Fig. 2 is a two-unit project, the older workings of No. 1 pit being shown in the background at *A*, the territory of the No. 2 pit occupying the bulk of the view. The original box cut of the No. 1 pit was made along the line of the deep valley between it and the newer No. 2 pit. The No. 1 workings pivot around a point where the waste-cone ridges apex, fanning out to the left on a large-radius circle overcasting to the outside.

The waste-cone ridge shown at *B* is the overburden from the original box cut for the No. 2 pit. The two-unit operation usually necessary for a box cut is shown in Fig. 1. Working through virgin ground on this initial cut, the overburden must necessarily be stacked on the natural surface, whereas the next cut will merely involve refilling about half the present excavation where the coal has been removed. Wasting on the natural surface makes too high a lift for the stripping shovel alone, so a long-reach dragline precedes the stripper, removing a predetermined depth that will enable the shovel to complete the excavation within the range of its maximum dumping height. As will be noted in Fig. 1, the dragline excavation is carried beyond the line of the box cut, thus giving extra depth for the shovel wastage. The long reach of the dragline enables it to cast any required distance to the rear, but it is slower than the shovel and is given the minimum work necessary to attain the desired results.

Returning again to Fig. 2, the general direction the stripping is advancing in the No. 2 pit is shown by the unlettered arrows. The face of the present stripping is at *C*, with the stripping shovel immediately back of it. The thin black line along the approximate center of the pit bottom shows the edge of the coal seam, extracted to the left and still in place at the right; the offset in this line back of the stripping shovel is where the smaller coal-loading shovel is loading out a 30-ft. width of the coal bed for transportation to the tipple.

The relation of the different units at the working face of the pit is shown in detail in Fig. 3, the stripper in the background overcasting to the right where the coal was previously extracted, and the coal-loading shovel making its new cut behind the partly loaded train. Haulage practice is less standardized than most other stripping practices. Some companies still adhere to the small dump car on narrow-gage track, and we are still far removed from the 100-ton cars now going into service in the Utah open-pit copper mines. The United Electric Coal Companies have adopted 44-ton automatic drop-bottom standard-gage cars and all-driving-wheel locomotives. They have a 50 per cent greater rail contact than the standard six-wheel switching engine, combined with a much higher starting torque. The track is laid as the box cut advances and is thereafter shifted over with each succeeding cut.

Fig. 4 shows the layout adopted for the No. 11 DuQuoin Mine of the United Electric Coal Companies. This is the largest coal-stripping operation in this country, containing 65,000,000 tons of coal, and is being developed with the largest and most modern equipment.

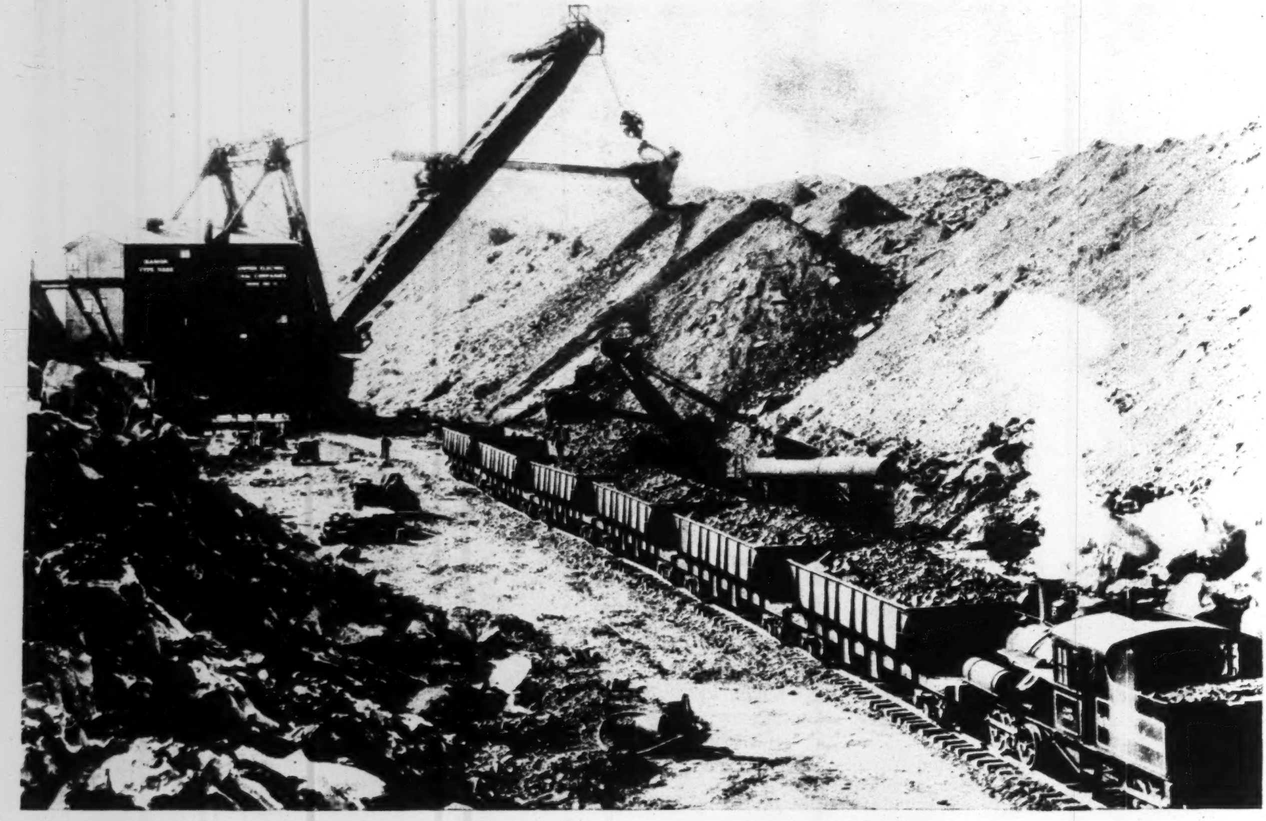


Fig. 3—Stripping shovel is shown removing overburden, and loading shovel is excavating coal.

This layout contemplates three units, two of which are now in production on the left limits of the property, with the third proposed unit going up into the center as shown. This last unit will fan around in the direction indicated by the arrows until it meets the No. 1 unit approaching from the other direction, as shown. The No. 2 unit will work over the territory between it and the proposed No. 3 unit, which will be in operation before the No. 2 unit reaches it. The coal outcrops, as shown on the map, are the workable limits only, the seam having been eroded and later covered with surface wash material to varying depths and seldom showing at the surface. The location of the tipple and railroad tracks is shown, and the area exhausted to the first of the current year is indicated by stippling.

When market conditions justify, the large stripping shovels are operated continuously day and night to take up all possible slack in interest charges, which are around $100 a day on such a shovel as the 5600. The excavating engineer may find it difficult to adjust his perspective to such carrying charges, which are not to be confused with intermittent rental charges, and which the strip engineer has only arrived at through a process of evolution. Against this, as an elementary example of the shovel's earning capacity, it may be pointed out that, with higher ratios of overburden, the 5600 uncovers $2 worth of coal at a bite, the operating cycle of which requires only 50 seconds.

The shovel crew consists of an operator and assistant and two ground men, with only intermittent supervision by the pit foreman and mine superintendent, whose efforts are concentrated more on the larger crews involved in keeping the coal moving to the tipple. This crew is standard for both large and small shovels, so the operating economy of the 15-yd. shovel over the 8-yd. unit is apparent.

To those accustomed to the noisy internal combustion or steam-powered shovels, perhaps the most surprising feature of the large electrics is the smooth, quiet operation. The meshing of the gears and hum of the motors at full load are comparable with the subdued droning of a large turbine-generating station, creating a marked misconception of the tremendous forces at work, until one observes the dipper getting a bite in a 17-ft. stratum of hard, partly broken limestone. The 5600 has a minimum crowding power of 53 tons when digging, after deducting the weight of the dipper with full load, the total lifting power at the bail being 130 tons. The general atmosphere of a properly organized stripping job is o of quiet, orderly and (with the exce tion of the shovel itself) almost leisur procedure. But the performance of ea shift is carefully checked through au matic recording devices showing eve motion made by the shovel, with tin and power consumed.

Blasting overburden

The rather surprising ease wi which the modern high-powered shov appears to be handling a thick, har rock makes it difficult to believe it ma be laboring under a dangerous overload. Costly experience has adequately demonstrated the economy of systematic blasting under these conditions, and good judgment is necessary to determine when the overload on the shovel justifies the extra expense of blasting.

The heavy charges required in shooting thick overburden make the use of ordinary explosives almost prohibitive, and the industry has originated an application of liquid oxygen to this purpose. This is popularly known as L.O.X., and consists of a carbonaceous base, soaked with liquid oxygen. A very pure, highly absorbent lampblack and a granulated carbon are the most efficient bases and are made up in cylindrical cloth cartridges, 5x20 in., of 3-lb. weight, the cartridge absorbing 11 lb. or more of liquid oxygen.

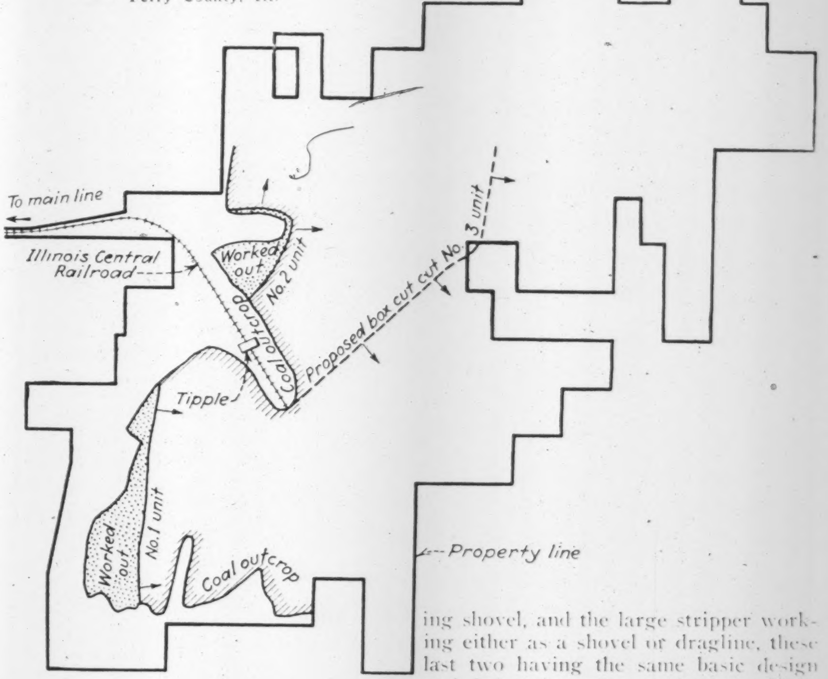
The highly volatile nature of the liquid oxygen makes it necessary to prepare this on the ground, for which a special plant is required. The interior of the DuQuoin L.O.X. plant of the United Electric Coal Companies is shown in Fig. 5. This is one of the latest and largest installations of its kind, costing about $75,000. It has a rated capacity of 200 lb. of liquid oxygen per hour, but this varies with the temperature of the air, the plant having maintained an average of as much as 284 lb. per hour over a period of a month. The oxygen from the air is compressed to 3,000 lb. per sq.in. and then allowed to expand to normal pressure, the very low temperatures developed in this rapid expansion (around minus 140 deg. C.) condensing or liquefying the oxygen.

The oxygen evaporates rapidly after the cartridge is soaked, the firing time for efficient results being limited to about an hour, and the cartridge becoming dead in six hours or less. For this reason the soaking is deferred until the last moment, and the whole firing operation is carefully synchronized, the soaked cartridges being transported to the holes in a fast light field truck equipped with a special covered box to keep evaporation to a minimum. No preliminary springing shots are necessary, as was formerly the case with other explosives. The first cartridge is lowered down the hole to make sure that there is no obstruction; the others are merely dropped in. The average charge is 6½ cartridges.

L.O.X. has a very high detonation rate of 17,248 ft. per second, which gives an exceptionally fine fragmentation in the 17 ft. of very hard and compact limestone at the DuQuoin mine, with holes at about 22-ft. intervals. Whereas boulders and large blocks of rock had formerly become accepted as a recognized evil under other blasting methods, complaints on this score are now rare.

In 1930 the plant produced 1,001,802 lb. of explosive at a cost of $64,402, exclusive of depreciation, taxes, insurance and interest; this makes an average cost of 6.43c. per pound, or a total of not more than 7½c. after all charges. L.O.X. is comparable with 60 per cent dynamite, the estimated cost of which at our plant would have been 15c. per pound.

Fig. 4—Stripping plan for new operation of United Electric Coal Companies in Perry County, Ill.



In 1931 there were 7,520 holes drilled to an average depth of 40.7 ft. at the DuQuoin mine, the total overburden blasted being 5,500,000 cu.yd., of which 37 per cent was rock. The average per cartridge was 114 cu.yd. Seven all-steel drilling machines are used; these weigh 9 tons each, are electrically operated and are self-propelling on full-length crawler treads.

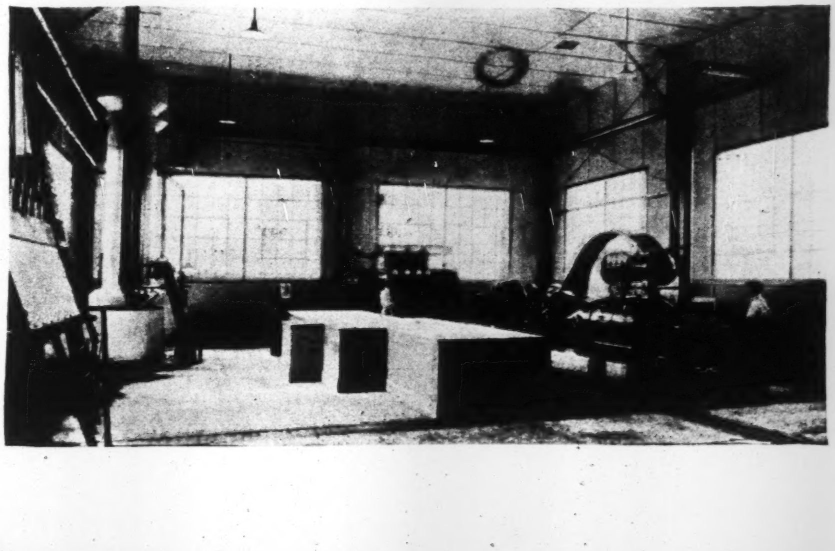
Power-shovel equipment

The shovels used in stripping are of three general types: the small coal-loading shovel, and the large stripper working either as a shovel or dragline, these last two having the same basic design and being interchangeable for whichever purpose is required. The leading dimensions of the smaller to the largest shovels are given in the table on p. 646, the letters in which correspond to those on the drawing, Fig. 6. In the table we have first the ordinary 38-ton type 450 with a 1¼-yd. dipper, commonly used on city excavation work and somewhat smaller than our type 37. Next, is the 95-ton type 490, with a 3-yd. dipper, which is the larger type used in loading coal at stripping operations. The 925-ton type 5480 is typical of the average-large machine now in general use at the strip mines, and the 1,750-ton type 5600 is the largest power shovel in the world. A comparison of the leading elements of these various shovels is shown in the table on the following page.

Coal-Loading Shovels—Though relatively diminutive compared with the large strippers, these are somewhat larger than the ordinary shovel on most construction work. We have adopted the type 490 shovel for this service, the standard dipper for which is 2¼ yd., as compared with the 1- to 1¼-yd. shovels on general construction jobs. For coal-loading purposes we equip the machine with a 3-yd. dipper, the working conditions being more uniform and less severe than when operating in surface conglomerate with mixed rock and boulders. This is a full-revolving machine, electrically operated and very fast. It is mounted on crawler trucks and is operated with a 120-hp. induction motor, the hoist requiring 75 hp. and the rotating and crowding machines each 23 hp.

Draglines—General particulars of the

Fig. 5—Interior of plant for manufacturing liquid oxygen explosive.



LEADING DIMENSIONS, CAPACITIES, ETC., OF SHOVEL AND DRAGLINE EQUIPMENT AT THE FOUR MINES OF THE UNITED ELECTRIC COAL COMPANIES IN 1931

(Letters compared with dimensions indicated in Fig. 6)

		Stripping Shovels			Draglines				Loaders	
	Type	350	5,480	5,600*	37	490	350	5,480	37	490
	Working Weight, in Tons	690	925	1,750	55	80	590	825	65	95
A	Dipper or bucket capacity, cu.yd	8	12	15	2	3	6	10	2	3
B	Boom length, ft	90	90	120	50	50	150	170	28	32
C	Dipper-handle length, ft	56	64	83	...	...	...	...	18	19
D	Boom angle from horizontal, deg	45	45	45	30	30	30	30	47	52
E	Coal to top of sheave of boom, ft	80	87	116	31	33	93	106	26	33
F	Clearance under rotating frame, ft	14	15	19	6	5	14	15	6	5
G	Height of house above grade, ft	30	40	47	14	16	30	40	14	16
H	Gantry height above grade, ft	52	59	76	16	17	52	59	16	17
J	House height above lower frame, ft	21	22	30	10	10	21	22	10	10
K	Length of house, ft	47	51	65	16	17	47	51	16	17
L	Width crawler belt, in	36	36	36	28	28	36	36	28	28
M	Over-all width crawlers, ft	30	38	50	11	12	30	38	11	12
N	Length crawlers over all, ft	35	43	61	14	15	35	43	14	15
	Hoisting cable diameter, in	1½	2	2¼	¾	¾	1¼	1½	⅞	1
	Dumping height, max. ft	67	68	82	18	24	70	75	18	24
	Cars required for shipment	20	25	58	2	2	20	25	2	2
O	Length crawler truck, ft	12	15	21	14	15	12	15	14	15
S	Max. height cutting radius, ft	48	60	78	18	21	70	75	32	19
	Normal cutting radius, ft	106	117	147	48	50	148	168	32	19
	Dumping radius at max. height, ft	97	107	145	48	50	148	168	30	31
	Max. dumping radius, dipper horizontal, ft.	101	117	147	...	...	...	...	32	32
	Dumping height dipper handle, horizontal, ft.	47½	47½	64½	...	...	...	...	14	14
	Hoist motors, hp	175†	250†	450†	...	75	150†	250†	...	75
	Rotating motors, hp	105	125†	150†	...	20	105	125†	...	20
	Crowding motors, hp	85	150	150†	...	...	...	...	...	20
	Power, volts	4,400	4,400	4,400	440	440	4,400	4,400	440	440

*This machine is designed for a 20-yd. dipper, but it is now equipped with one of 15-yd. capacity, making it possible to use a longer boom and dipper handle and giving a wider working range. All the dimensions are as currently operating.

†Two motors, each of this horsepower.

maximum development in power shovels are given in the following section describing the 5600. Since these machines are convertible to either shovel or dragline use, the following particulars are confined to the special drag equipment and apply to the type 5480, which is the next largest machine.

Equipped for use as a drag, the dipper is supplanted with a bucket, a distinctive type of boom is installed, the handle and crowding machinery are dispensed with, minor variations made in cables, yoke sheave blocks, etc. The boom varies from 170 to 200 ft. long, with a 6-yd. bucket on the longer and a 10-yd. on the shorter. Our drags are equipped with a 170-ft. boom, which gives a stacking height of 75 ft. at 30 deg. from the horizontal, with a dumping radius of 168 ft. and a normal cutting depth of 72 ft. below grade, although this last can be extended materially if required. The 200-ft. boom has a dumping height of 92 ft. and a dumping radius of 195 ft., with a normal cutting depth of 54 ft.

A distinctive feature of this machine in dragline operation is regenerative braking. When the bucket is being lowered the hoisting motor is reversed with the friction bands engaged, causing the falling bucket to drive the motors, which throws power back into the line; this also reduces the wear on the brake blocks and eliminates excessive brake-housing heating. Through an ingenious double reeving of the hoist cable and a single reeve of the drag cable, a certain amount of the stored energy in the loaded bucket at the early part of the hoist is also delivered from the drag drum to the hoist drum.

Some discussion is still heard of the comparative merits of electric shovels and those powered with steam internal-combustion engines, but t only conditions justifying considerati of other than electric power in strippi practice today would be a lack of ad quate power supply to meet peak-lo demands, or its excessive cost. Wh there is something paradoxical in th use of purchased power at coal min the life of these operations does n justify the elaborate plant that woul be necessary to provide the maximu load requirements of several larg shovels pulling on the line at the sam moment. Electric-powered shovels co about 20 per cent more than steam shovels, and crawler mountings add 35 per cent above a wheel carriage.

The 5600 at DuQuoin

This machine is an unprecedented forward step in shovel design; it is roughly twice the size of the previous largest shovel. Some relative idea of its rather startling dimensions can be gained from Fig. 6, which shows how it compares with the next previous largest shovel and with the 1- or 1¼-yd. shovel that is a familiar sight on most excavation jobs.

A general view of the shovel is shown in Fig. 7. The cab, or housing, is comparable with a large two-story dwelling and has a 20-ton overhead electric crane to facilitate assembling and replacements. If the shovel were operating in a city, the point of the boom would reach the top of an eleven-story building and the dipper could stack material on an eight-story structure. It could take its bite on one street and dump an average city block away on another. The leading dimensions are given in the table.

The lower frame is of built-up structural steel, the outside members of which are 5 ft. deep at the ends and

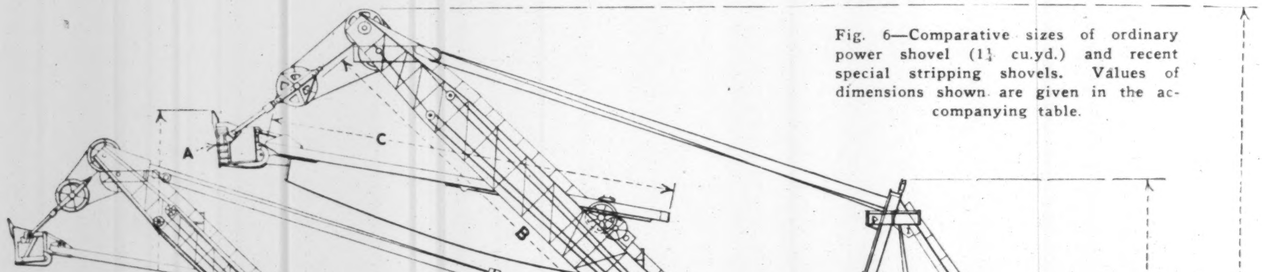


Fig. 6—Comparative sizes of ordinary power shovel (1¼ cu.yd.) and recent special stripping shovels. Values of dimensions shown are given in the accompanying table.

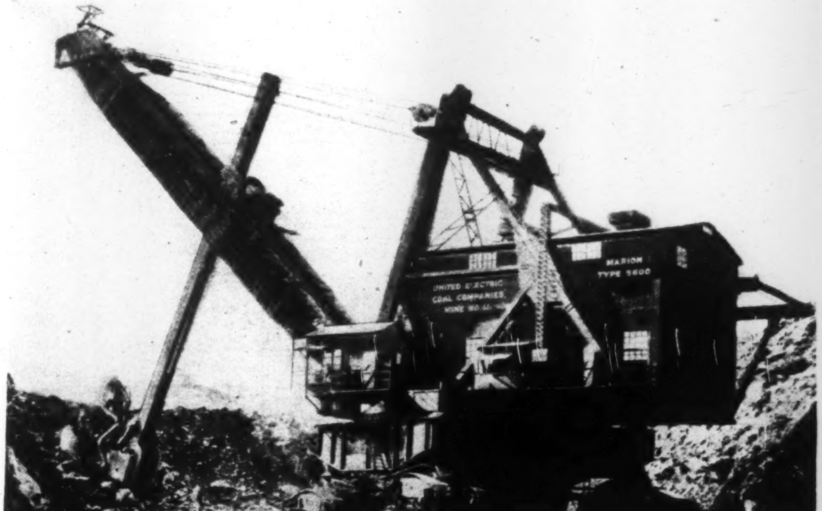
8 ft. 2 in. at the center, joined at the corners with heavy alloy-steel castings bored to carry the hydraulic equalizing jacks for leveling up after a move. There are duplex crawler trucks at each corner equipped with certain refinements in the way of mud-cleaning gears, etc.

The shovel is self-propelling in either direction at a rate of one-third mile per hour. The front and rear trucks can be steered independently, and the machine automatically levels itself through the hydraulic jacks at each corner. This gives the flexibility of a three-point suspension and permits the machine to operate on uneven ground without torsional strain due to unequal distribution of weight on the lower frame.

The hoisting machinery consists of two direct-current motors, shunt-wound for 230 volts, and equipped with blowers. The boom hoist is of the self-locking type, and is driven through a clutch from the hoisting machinery. The rotating machinery consists of two units on the front corners of the upper frame, both of the open-mill type and shunt-wound for 230 volts, d.c.

The shovel is equipped with a motor-generator set consisting of a synchronous motor for three-phase, 60-cycle, 4,000 volts, driving a 500-volt d.c. generator for the hoist and two 700-volt d.c. generators for the rotating and crowding motors, respectively. The total output of all motors and generators is about 5,500 hp. The various motor speeds are obtained by voltage control through a field resistor in each generator field, the resistance being varied by means of meter controllers in the operator's station. The reel for the cable to the power line is carried in a structural-steel support on the rear girder of the lower frame; it is oil-insulated in an oil-tight reservoir and is provided with slip rings, brushes and connections. Transformers are installed for operating the air compressors, blower motor, lights and hydraulic jacks.

Fig. 7—Giant 15-yd. electrical shovel for coal-mine stripping operations of United Electric Coal Companies.



The boom is of the box-girder type, made up of two main interior and two outer auxiliary steel trusses, connected with top and bottom plates, diagonals and interior bulkheads. The dipper handle is of composite steel and wood construction made up of two members having steel armor plates on both sides and heavy steel bars on top and bottom.

The dipper weighs 32 tons empty. The front is a single manganese-steel casting, riveted to the side plates, which are reinforced and riveted to the dipper back, consisting of a single alloy-steel casting. The teeth are manganese-steel, and the door is a single piece of plate steel. There is a motor-driven drum for tripping the latch bar on the dipper, which is operated by a switch located in the hoist-controller handle. Complete lighting equipment is provided for night operation, including floodlights, house lights and lights on the lower frame.

Stripping costs

It is to be taken as axiomatic, of course, that the heavy investment in stripping equipment limits the possible adaption of these methods to only the largest and preferably the concentrated volumes of excavation work; but the strippers are showing substantially lower costs than any others of record, adequately justifying consideration of these methods to adaptable conditions. The large-scale excavation in recent levee work seems to be the nearest modern approach to the volume of material handled by the strippers.

The principal constructive factor making for economy in stripping excavation is the simple short-range overcasting of the material. There is no haulage in wasting, and rehandling with a booster shovel is the exception. Close prospect-drilling to prove the integrity of the coal seam provides abundant advance data on the thickness and character of the material; unstable bearing surfaces requiring mats are rare. Stripping organizations are more permanent, with minimum losses from moving on a new job and getting organized. Grubbing is never a factor, since the large electrics will lift out a small farmhouse in a few bites. The principal difficulties encountered by the stripper follow:

1. Higher stacking. Strippers are commonly stacking to 40-ft. heights, not infrequently to 50 ft., and sometimes more. The average large shovel stacks to 50 ft. in general operation, but the last 5 ft. creates strains making for high maintenance charges that do not justify constant working at these heights.

2. Limited operating range. The stripper can usually excavate only to half its normal working radius; if it undertakes more, there is excessive loss of stacking space in the wider valleys between the waste-cone ridges.

3. Selective stacking. Unlike permanent fills, our waste banks are maintained only until the coal at the toe is removed, and repose angles are frequently set at dangerously narrow margins to keep the stacking height to the minimum. A more or less careful sorting of heavy rock at the toe of the bank builds up the base, increasing the section and decreasing the height, but tending to slow down the shovel.

4. Idle-time losses. Contrary to the usual custom in general excavation of crowding work to the limit, the strip engineer faces discouragingly long shutdowns through adverse conditions in the coal market, when his average costs must absorb large carrying charges on expensive equipment. Unavoidable idleness for general overhauls, long moves and other enforced operating delays have set a maximum practicable working limit of 70 per cent on a year-in-and-year-out basis for all equipment. It is doubtful if any of the large strippers operated their equipment more than 50 per cent of the time in 1931.

5. High wage scales. The large stripping operations of Illinois and Indiana are in the closest unionized section of the country with the highest wage scales, and are subject to union rules and regulations that are sometimes prejudicial to the most efficient operation.

These are the continuing everyday handicaps in stripping practice, which are not infrequently supplemented by others, such as blasting expense, costly ditches or drainage problems. In general, it might be said that none of the large stripping shovels has ever been tested on a large straightway excavation free from the above adverse operating factors, which would mean a considerable improvement on the existing costs.

Actual 1931 cost figures at the several mines of one large stripping company, operating around 50 per cent capacity, varied from 5.3 to 7c. per cubic yard, while another large company showed costs ranging from 7.1 to 9.5c. per cubic yard. Costs on the larger levee construction appear to vary from 11 to 32c. a cubic yard, averaging around 22c. One large job in 1931, involving 3,500,000 cu.yd. and constructed by the army engineers, showed a cost of 18c. per cubic yard.

The stripping-cost figures are conservative in that they represent performances for the worst year in the history of the coal industry; they include adequate depreciation charges, together with a substantial pro-rata share of the general mine overhead—probably more than would be the case on any construction job. It is difficult to estimate the relative difficulties of levee and stripping excavation in dollars and cents, but it does not seem unreasonable to balance the higher stacking of the stripper against the longer horizontal movement on levee work. Assuming these respective difficulties to be comparable, the spread in cost between the two methods would seem a conclusive argument for the large-capacity equipment where conditions justify it.

The only logical comparison, of course, would be to a situation adaptable to the stripping shovel as, for example, a long canal about 20 ft. deep, where it could work continuously 24 hours a day, wasting to either side without straining to maximum stacking limits. Deeper projects of this description could be handled equally well with supplementary draglines, or by working shovels in tandem. These large-capacity units have clearly revolutionized former concepts as to large-scale excavation costs, and it is not unlikely that the experienced strip engineer, familiar with what can be expected of these large shovels under specific conditions, could effect important downward revisions in some of the larger canal projects now under consideration.

Displaced Caissons Restored at Shimidzu Harbor, Japan

Eleven-thousand-ton concrete caissons shifted by earthquake realigned and releveled under quaywall by reflotation

By Teizo Simano

Engineer, Shimidzu Harbor Works, Shimidzu Harbor, Japan

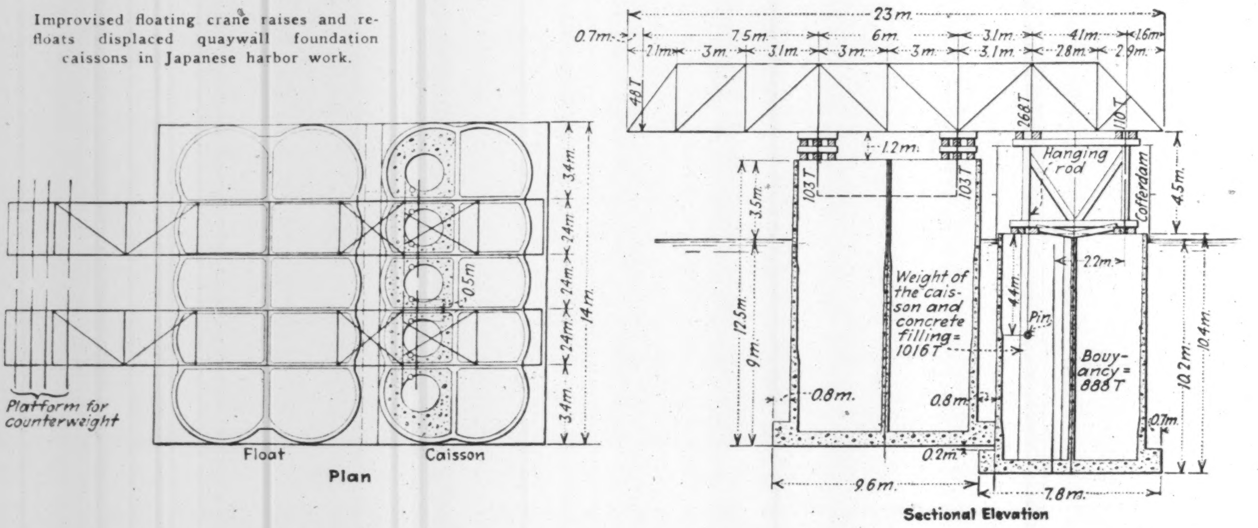
QUAYWALLS forming a part of the harbor works at Shimidzu, Japan, which had been shifted and tilted by the earthquake of November, 1930, have recently been restored by realigning and releveling the old cellular concrete foundation caissons by a successful reflotation process. The wall, about 28 ft. deep and 656 ft. long, slid out about 26¼ ft. and settled about 5 ft. at points of maximum movement.

The wall consisted of reinforced-concrete caissons, having the dimensions shown by the accompanying drawing, surmounted by a parapet wall. The caisson tops were about 3 ft. above low-water level and were bottomed a gravel fill in a trench excavated the soft clay of the harbor bed. T outside cells were filled with conc except for a cylindrical core of gra and the rear cells were filled w gravel. The caissons were built ways, launched, floated into place a sunk in the familiar way.

To restore the wall the parapet w removed and the caissons were rai and reset to the original level and li by emptying and floating them off t bottom. Without gravel fill, a caiss weighed about 1,117 tons and had buoyancy of 976 tons. The caisson wa prepared for flotation by extending t outer walls upward above danger submergence by a temporary ste cofferdam. The gravel fill was the removed and the water was pumped ou

To provide the floating power i excess of the buoyancy an improvise floating crane was constructed as show by the drawing. For the float or hul of the crane a caisson designed fo another part of the work was presse into service. Across its top four stee trusses were fastened and braced a indicated. One arm of the cran bridge was weighted and the other arm was provided with lifting rods an shackle for taking hold of the caisson to be floated. The complete procedure was then as follows:

The cofferdam top was constructed and the caisson emptied of water and gravel fill. Holes were drilled through the partition walls and pins fixed in them for connecting the eight lifting rods from the crane truss. After the crane float was brought alongside the caisson to be raised it was sunk by letting in water until the lifting rods were lowered far enough to connect with the lifting pins. With all fastenings completed the float pumped out and the rising crane lifted the caisson off the bottom and floated it in a level position ready for replacement on new foundations.



Plan

Sectional Elevation

Improvised floating crane raises and refloats displaced quaywall foundation caissons in Japanese harbor work.

Results of Tests on Siphon Spillways for Large Flume

Close regulation of water surface in large concrete conduit on Mokelumne project is secured by siphon wasteways—Tests modify original design—Siphon primes with 0.26 ft. of overflow

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Accurate Data on the design and operating characteristics of siphon spillways are not overly abundant. Behavior at time of priming and efficiency as determined by the coefficient of discharge are factors the investigation of which is a particularly fertile field for operating tests to check theoretical considerations. Therefore, the following description of a series of accurate tests made on units designed to meet exacting requirements and the subsequent improvements effected are a distinct contribution in this field of hydraulic design. Under certain conditions the use of siphon spillways provides distinct advantages, and the more assurance the designer has of operating results that will agree with the design the more effective will be the utilization of this device. —Editor.

Siphon spillways were selected to discharge excess flows occurring in the Tiger Creek conduit of the Mokelumne River power development of the Pacific Gas and Electric Co., California, on the basis of reliability, close regulation of water-surface elevation, low cost and freedom from maintenance. Seven siphons were installed at points where feeders enter the 20-mile concrete conduit line, and tests were made on four to check performance and to effect possible improvements in design. The test procedure and resulting modification in design and efficiency are described in the following.

Conduit—The Tiger Creek conduit is an important feature of the new hydroelectric development of the Pacific Gas and Electric Co. on the Mokelumne River in California. With a capacity of 550 sec.-ft., it extends from the Salt Springs dam to the Tiger Creek forebay and consists of 15.9 miles of concrete bench flume, 2.7 miles of tunnel, 1.5 miles of elevated concrete flume and 0.2 miles of steel-pipe inverted siphon, making a total length of 20.3 miles. At several points along the conduit, feeder flumes pick up the flow of tributary streams. During certain seasons the runoff from heavy rain or melting snow increases the pick-up from these feeder flumes to such an extent that the main flume would be overtopped unless protected by automatic spillways. The size and importance of the conduit made the selection of type, design and operation of these wasteways of particular importance.

Characteristics of each siphon are shown in Table I and typical cross-sections in Fig. 1. Each of the siphons with inclined lower leg was provided with an auxiliary priming weir and a vertical bend near the lower end of the barrel, to assist in starting siphon action. The vertical bend was included to cause the thin initial sheet of water to jet to the top of the barrel, thus forming a curtain to prevent entrance of air from below. The field tests were carried out to check the rise in water-surface elevation required to prime the siphons and to prove the adequacy of their capacity.

Test of Siphon No. 3—The principal tests of design and operating characteristics were made on siphon No. 3 located on the Bear River feeder flume 100 ft. upstream from its junction with the main conduit. A radial check gate located 100 ft. downstream from this junction made an ideal set-up for this test. Four piezometer connections, located as shown in Fig. 2, were built into one of the twin barrels. Mercury-filled U-tubes with the necessary interconnecting hose and shut-off valves were connected to these piezometers. Before starting the test the other barrel was closed with boards to conserve water and to reduce the discharge to a quantity that could be supplied by the main conduit while a current-meter measurement of the flow was being made.

The flow in the main conduit during the test was 450 sec.-ft. In making each run the check gate was partly closed to back the water up in the feeder flume until the siphon primed or the water surface rose as high as the available freeboard permitted. In run No. 7, after the siphon had primed, the gate was still further adjusted to maintain as nearly as possible a constant water level during the current-meter measurement. Water-surface elevation adjacent to the siphon was obtained by use of a portable stilling-well gage. The results of tests on siphon No. 3 are summarized in Table II.

The first attempts to operate this siphon as originally built were unsuccessful, and various modifications were devised and tried out before an entirely satisfactory means of causing priming was obtained. In a preliminary series of tests several types of sills or baffles fastened across the floor of the siphon barrel were tried in various locations. None of these proved capable of starting siphonic action with the 7-in. depth of overpour permitted by the available freeboard.

During these preliminary tests it was noted that the vertical bend near the lower end of the barrel was not entirely effective. The wall between the two barrels (Fig. 3) stopped abruptly, leaving an entrance for air to the under-side of the sheet of water, which was deflected to the roof of the barrel by the bend. As a result there was only one sheet of water through which the air had to break to prevent the formation of a vacuum higher up in the barrel.

Improvements Made—Run No. 1

TABLE I — SIPHON SPILLWAYS ON THE TIGER CREEK CONDUIT

Spillway No.	Designed Capacity, Cu.Ft. per Sec.	Head, Ft.	Barrels No.	Barrels Size, Ft.	Barrels Inclination	Sealing Pool	Type (See Fig. 1)	Location
2	310	25	2	1.0x6.5	Vertical	Yes	A	Cold Creek feeder
3	575	23	2	2.0x6.25	41° 30′	After test	B	Bear River feeder
4	100	19	1	1.0x3.25	Vertical	Yes	A	East Panther Creek feeder
			1	0.75x2.25				
5	100	7	2	1.0x3.25 0.75x2.25	Vertical	Yes	A	West Panther Creek feeder
6	200	10	2	1.0x6.5	Vertical	Yes	A	Deer Creek
7	640	23	2	2.0x7.0	41° 30′	After test	B	China Gulch
9	660	35	1	1.5x1.5	30° 20′	No	C	Tiger Creek Forebay
			1	1.5x3.0				
			2	1.5x5.5				

TABLE II — TEST OF SIPHON SPILLWAY NO. 3

Run No.	Time, Hours and Minutes	Water Surface Elevation Above Crest	Stage	Vacuum at Piezometers No. 1 — Feed of Water in Column	2	3	4	Remarks
1	10:52	0.26		0.11	0.00	0.11	0.11	2x8-in. plank across bottom of barrel 8 ft. below crest.
	10:55	0.33		0.23	0.00	0.17	0.17	
	11:00	0.44		0.23	0.06	0.23	0.23	
	11:02	0.46		....	....	....	....	
	11:04	0.52	Failed to prime	0.34	0.11	0.28	0.34	
	11:10	0.60		....	....	....	....	
2	12:08	0.06		0.11	0.11	0.00	0.34	Plank 8 ft. below crest. Wooden extensin of wall between the two siphon barrels. 3-in. pipe air ejector down center of barrel.
	12:09	0.41		0.51	....	....	0.57	
	12:10	....		0.57	....	....	....	
	12:11	0.60		0.68	....	....	0.68	
	12:14	0.59	Failed	0.57	....	....	....	
	12:17	0.65	to prime	1.02	....	....	1.02	
7	9:29	0.00		....	....	....	....	Plank 8 ft. below crest. Extended wall. Current-meter measurement. $Q =$ 329 sec.ft. Vortex allowed air to be drawn into siphon intake. Slight vibration noticeable. Plank torn out by discharge.
	9:30	0.32		....	....	....	....	
	9:30½	0.47		....	....	....	....	
	9:31	0.57		....	....	....	....	
	9:31¼	....	Primed	....	....	....	....	
	9:31½	0.46		7.9	25.0	16.4	14.2	
	9:32	0.04		....	....	....	....	
	9:39	0.10		9.1	23.8	18.1	19.3	
	9:43	....	Vacuum broke	0.0	0.0	0.0	0.0	

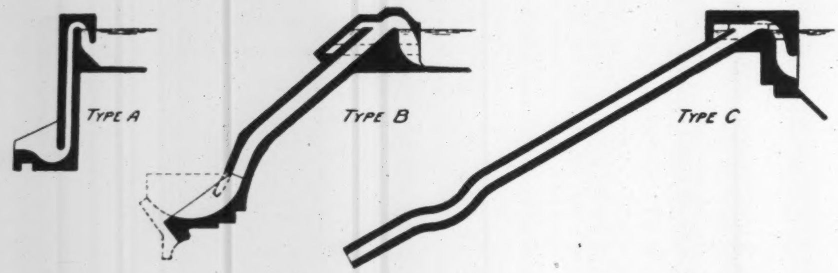
Type A
Type B
Type C

Fig. 1—Three types of siphons used in the tests. The dotted lines at the outlet of type B show the sealing pool added as a result of the tests.

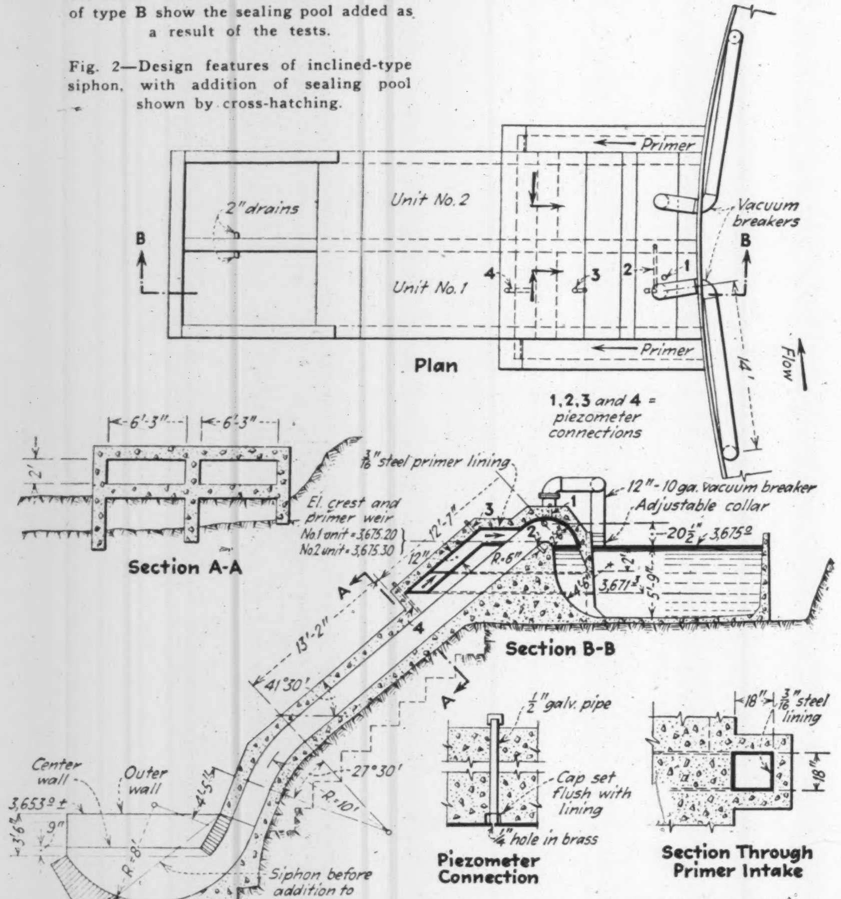
Primer
Unit No. 2
2" drains
Vacuum breakers
B
B
4
3
2
1
Unit No. 1
Primer
Plan
14'
Flow
1, 2, 3 and 4 = piezometer connections
6'-3"
6'-3"
2'
Section A-A
3/16" steel primer lining
El. crest and primer weir
No.1 unit = 3,675.20
No.2 unit = 3,675.30
12'-7"
12"
R.6"
12"-10 ga. vacuum breaker
Adjustable collar
20½"
3,675.0
3,671.3
5'-9"
A
13'-2"
Section B-B
41°30'
A
Center wall
Outer wall
3,653.0 ±
9"
4'-5¼"
27°30'
R.10'
R.8'
Siphon before addition to lower end
2" drain
½" galv. pipe
Cap set flush with lining
¼" hole in brass
Piezometer Connection
18"
3/16" steel lining
18"
Section Through Primer Intake

Fig. 2—Design features of inclined-type siphon, with addition of sealing pool shown by cross-hatching.

(Table II) was a repetition of one of the preliminary tests but with vacuum gages attached. Then, to make use of the additional vacuum-producing curtain of water falling from the roof at the lower end of the barrel, a wooden extension of the wall between the two barrels was built. Further, a 3-in. pipe was fastened to the floor of the barrel, extending from the throat to the vertical bend. This pipe was intended to act as an air ejector. Run No. 2 was made with this arrangement, and the gages showed considerably greater vacuums, but still the siphon failed to prime. This failure was ascribed to the break in the sheet of water, caused by the obstruction offered by the ejector pipe, through which air could enter. This break was noticeable at the outlet.

The pipe was removed, and several runs were made which indicated that the siphon would prime if a 2x8-in. plank was placed flat across the floor of the barrel 8 ft. below the crest. Run No. 7 gives data on the siphon under these conditions; Fig. 4 shows the solid water at the outlet during this run.

The 7-in. rise in water surface required to start the siphon, as indicated in run No. 7, was considered excessive, so additional alterations were undertaken. The roof of the lower end of the barrel was extended, and a temporary sealing pool was constructed, as shown by hatched lines in Fig. 2. Altered in this way, the siphon primed with a depth of only 0.31 ft. over the crest. The replacing the plank in the barrel, priming took place with only 0.26 ft. over the crest, but it is [illegible] this decreased depth w[illegible] were in the water surf[illegible] rather than the presence of the plank. With the priming waterway closed by boards and the plank removed, the depth to start the siphon was 0.41 ft. The discharge for a depth of 0.41 ft. over a weir is just twice that for a depth of 0.26 ft. In other words, for a depth of 0.26 ft the discharge over the crest of the siphon plus that over the primary weir is the same as the discharge for a depth of 0.41 ft. over the crest alone. Therefore, it appears that the only function of the priming weir in this siphon is to increase flow and lower the depth required for starting action. This indication, that the flow over the priming weir failed to seal the barrel and assist in rarefying the air in the throat, is confirmed by the vacuum readings, which were practically the same on both sides of the priming weir.

Coefficient — The coefficient of discharge, C, was 0.69, based on the flow measure during run No. 7 and computed by the following formula:

$$Q = CA\sqrt{2gh}$$

Where Q = 329 sec.-ft.
A = 12.5 sq.ft. = area at throat
h = 22.6 ft. = head between intake water surface and center of outlet.

This coefficient as computed neglects the fact that some water was flowing through the breaker pipe and the priming waterway. This additional flow of course reduced the quantity through the main intake and throat and theoretically, at least, reduced the friction and entrance losses, thereby increasing the coefficient of the siphon. However, it can be assumed that the amount of water thus bypassed was comparatively small due to the sharp entrance and right-angle bend losses in the priming waterway, and the coefficient is therefore only slightly affected.

Tests on Siphons No. 4 and No. 7—Siphon No. 4 (type A in Fig. 1) was tried by an operating crew and found to function satisfactorily.

Siphon No. 7 (type B, Fig. 1), identical to No. 3, was extended and provided with a similar sealing pool. It was then tried and found to prime with a depth of only 0.10 ft. over the crest. The rate of rise of the water surface in this trial was very slow, giving considerable time for rarefying the air in the barrel. There seems to be no reason why siphon No. 3 would not also prime with this slight overflow if the water were raised slowly. Fig. 6 shows this siphon with full discharge from one barrel.

Test of Siphon No. 9—Siphon No. 9 at the forebay is of type C, Fig. 1,

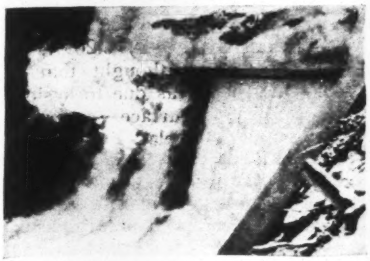

Fig. 3—Outlet of siphon No. 3 as originally built discharging about 20 sec.-ft. without priming.

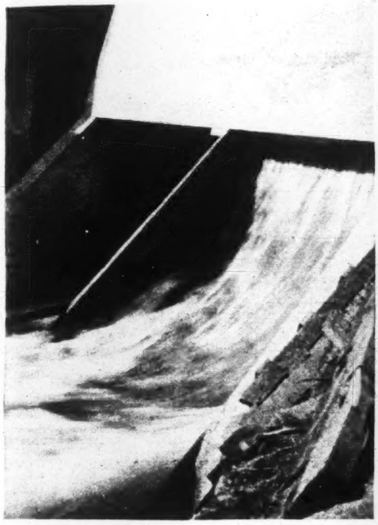

Fig. 4—One barrel of outlet No. 3 discharging 329 sec.-ft. after a temporary center-wall extension had been added.

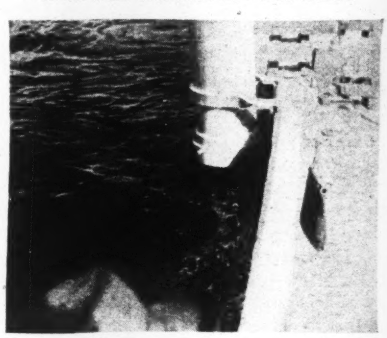

Fig. 5—The breaker pipe at one siphon spillway continued to draw up column of water after the water level fell below the pipe end.

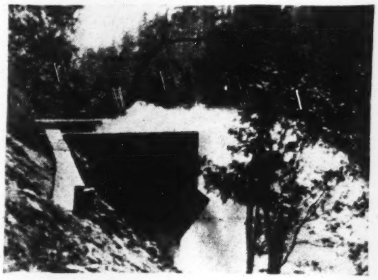

Fig. 6—Outlet of siphon No. 7, discharging 360 sec.-ft. through one barrel.

with the addition of a vented concrete transition at the lower end and a steel waste pipe for final discharge (Fig. 7). There was, therefore, no way of forming a water seal at the lower end of the barrel. The depressed section, or double vertical bend, was relied upon to furnish the seal and to rarefy the air. Connections for the vacuum gages for the tests of this spillway were made by tapping into the vent or siphon breaker pipes.

Tests of this siphon consisted of two runs. The first run was made on one barrel only to determine the depth of overpour required to cause priming. Two of the four barrels were closed off by board shutters across the intake. The crest of the fourth barrel is at a slightly higher elevation and therefore did not need to be blocked. The water surface was raised at the rate of 0.04 ft. per minute, and priming occurred at a depth of 0.28 ft. over the crest.

The object of the second run was to determine the maximum rise in water surface that might be expected during normal operation of the spillway. It was made with all the barrels open and with a water surface [illegible]ing at the rate of 0.14 ft. per minute [illegible]ests of the four barrels composing [illegible] spillway are set at three different levels. The smallest barrel is set to prime first. The crest of the next larger barrel is 0.1 ft. higher, and the crests of the two largest barrels are 0.2 ft. higher than the crest of the smallest. In this run the maximum depth over the crest of the smallest barrel was 0.42 ft., or 0.22 ft. over the crests of the two largest barrels. The four barrels primed in rapid succession with less than a minute elapsing between the priming of the first and last.

The U-tubes at the time of priming indicated a vacuum equivalent to 0.5 ft. of water, which is less than half the vacuum required to prime siphon No. 3. The actual vacuum at the throat is unknown, as no piezometers were built into this siphon. No measurement of discharge was obtained, but the rate of drawdown in the forebay indicated a flow approximating the designed discharge.

Conclusions—These tests indicate the necessity of sealing the lower end of inclined siphon barrels either by a sealing pool, which is probably most effective, or by vertical bends causing the sheet of priming water to jet across the barrel several times. The latter method is less positive than the sealing pool.

Where a siphon is required to work on a very small rise in the intake water surface, as in cases where the freeboard is very limited, the auxiliary priming weir seems to be justified, since in these tests it reduced the depth at which priming occurred by nearly 2 in.

The advantage of a low throat section, in regard to the vacuum required for priming, is shown by the tests of siphons No. 3 and No. 9. Siphon No. 9, with a throat 1.5 ft. high, primed with a vacuum equivalent to 0.5 ft. of water, while siphon No. 3, with a throat 2.0 ft. high, required a vacuum of more than 1.25 ft.

With enlarged inlets submerged as in the siphons tested, there is very little disturbance in the water surface adjacent to the inlet. Therefore, the vacuum breaker pipes could as well be placed directly in front of the inlets instead of to the side. A small vortex, allowing the entrance of air, formed during only one run of siphon No. 3. This air did not affect the vacuum reading, which were about the same for all runs. According to these tests the ends of down-turned vacuum breaker pipes, with an area of 6 per cent of the throat area, should be about 2 in. above the water-surface elevation at which it is desired to stop the siphon. Fig. 5 shows the siphon still operating with water surface below breaker pipe and a solid column of water being drawn into the pipe.

Discharge through these siphons started and stopped very smoothly, and the operation was without serious vibration at any time. The addition of the sealing pool did not cause pulsation, as has been described at other siphons.

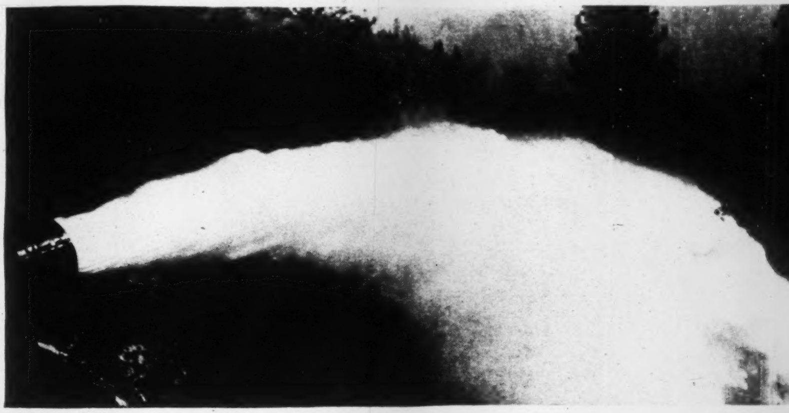

Fig. 7—Waste pipe from No. 7, discharging about 660 sec.-ft.

and it apparently had no effect upon the discharge.

The main objective in making these tests was to prove that the siphons would prime with the available freeboard and that their capacity was sufficient. When the siphon did not prime, the tests were continued to indicate what alterations should be made. The collection of theoretical data was incidental. In making tests for this latter purpose the following points should be observed: (1) more piezometer connections should be installed; (2) oscillations of the mercury column should be damped; and (3) the rate of rise of the water surface should be controlled.

These tests were made by the authors with the cooperation of F. C. Scobey, senior irrigation engineer, U. S. Department of Agriculture. G. M. Wehrle, superintendent of construction, and his assistants controlled the operation of gates and the power house during the test of siphon No. 9. The design of the project was directed by I. C. Steele, chief, and Walter Dreyer, assistant chief of the division of civil engineering, Pacific Gas and Electric Co., San Francisco, Calif.

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Sockets of Low-Melting Alloy Best for Wire-Rope Test Samples

Samples socketed with spelter broke near sockets and gave lower strengths than samples socketed with 83-7-10 lead-tin-antimony alloy

By D. H. Corey and E. T. Cope
Research Department, Detroit Edison Co., Detroit, Mich.

IN CHECKING the tensile strength of purchases of new wire rope the Detroit Edison Co.'s research laboratory experienced difficulty in developing the specified breaking strength. The threatened rejection of purchases of wire rope, which resulted in controversy with the vender, led to a search for a more satisfactory method of holding the ends of the rope samples during tests to determine the breaking strength.

A conventional method, whereby closed conical wire-rope sockets were attached to the ends of the sample, using spelter as the holding medium, had been in use for some time but was not entirely satisfactory. The preparation for testing was as follows: the ends of the specimen were served (bound) with iron wire at 6 in. and 1 in. from each end. The conical sockets were then slipped over the ends of the specimen, the outer servings removed, the wires "broomed," and the hemp core was cut back to the inner servings. After being cleaned thoroughly in gasoline, the wires were dipped in hydrochloric acid and tinned with the spelter with which the sockets were to be filled. Each socket was then pulled over the broomed end of the rope specimen until the inner serving (the one not removed) was immediately outside the small end of the socket. The spelter was then poured into the socket until it was completely filled.

Specimens that were tested after preparation in this manner had failed almost without exception, either at one of the sockets or within such a short distance from one of them as to make it appear that the rope might have been affected by the socketing procedure. A proposed explanation for this decrease in tensile strength was that the skin hardness, resulting from cold drawing of the wire in manufacture, had been decreased at the temperature at which the spelter was poured—about 1,000 deg. F. An investigation was therefore undertaken to determine whether the use of an alloy of lower melting temperature would result in more satisfactory tests.

Several wire-rope samples were prepared, some with spelter and some with two alloys of comparatively low melting temperatures (below 550 deg. F.) which were reported to have been used with success elsewhere. (See "Johnson's Materials of Construction," rewritten by M. O. Withey and James Aston, 6th edition, p. 671.) Additional samples were included to determine whether anything was to be gained by the use of oversize sockets, permitting the wire ends to be doubled back toward the center of the rope, thus embedding greater length of wire in the holdin medium.

The wire rope used for these tes was ½-in. 6x19 rope with hemp cor From a single length of this rope thre groups of samples were prepared fo tests, each sample 5½ ft. long. The results of the tests are given in the tabl

Commercial zinc (spelter) was use in group A. The alloys used in group B and C were of the following proportions, in per cent of weight: group B lead 83, tin 7, antimony 10, group C lead 60, tin 30, antimony 9, bismuth 1 The pouring temperatures were: group A, 1,000 to 1,050 deg. F.; group B, 500 to 650 deg. F.; group C, 480 to 575 deg. F.

As a result of these tests it was concluded that either of the two low-melting alloys would be entirely satisfactory. The group average of the tensile strength was greater than when using spelter, and the variations of individual samples from the group average were less. The location of the failures was such that it appeared that the full strength of the rope was being developed. The tests indicated, further, that there is no need for the extra work entailed in bending the wire ends inward to embed a greater length of wire. When care is exercised in cleaning and tinning, a sufficient bond is obtained between the straight wire ends and the holding medium to prevent any slipping of individual wires.

The alloy used for the group B samples was adopted as the alloy to be used in preparing all wire-rope samples for tensile tests. Subsequent tests have been entirely satisfactory.

Although the differences in the group averages reported in the table may be of little practical importance to field users of wire rope, these differences and the visible evidence of a satisfactory test are of considerable importance to an organization called upon to test rope, the acceptance of which, after purchase, is conditional on conformity with minimum tensile-strength specifications.

THREE SOCKETING METALS COMPARED IN TESTS OF ½-IN. WIRE ROPE

Group	Metal or Alloy Used as Holding Medium	Sample Designation	Breaking Load Pounds	Breaking Load Variation From Average Per Cent	Distance From Break to Nearest Socket, In.	Average Breaking Load of Each Group, Per Cent Variation From Average of Group B
		1	20,400	0	1½	
		2	20,100	−1.5	1	
		3	22,000	+7.8	1	
A	Spelter	*4	18,700	−8.3	1	
		*5	19,700	−3.4	0	
		*6	21,400	+4.9	0	
			20,400			−6.8
		7	21,700	−0.9	3	
B	Pb, Sn, Sb Alloy	8	21,800	−0.5	26	
		9	22,300	+1.8	3	
			21,900			
		10	22,200	+3.3	14	
		11	21,400	−0.5	1½	
C	Pb, Sn, Sb, Bi Alloy	12	21,300	−0.9	1½	
		*13	21,700	+0.9	15	
		*14	22,000	+2.3	2	
		15	20,400	−5.1	3	
			21,500			−1.8

*¾-in. sockets used, wire ends doubled back toward center of rope.

New York Subway Construction—IX

Underpinning Elevated Railroads

Difficult task of supporting numerous elevated columns on Queens Plaza section handled by novel methods

By Frederic R. Harris

Consulting Engineer, New York City

In the Construction of New York's independent subway system it is frequently necessary to build the new subway below existing elevated rapid-transit lines. In such cases the shallow column foundations of the elevated are directly in the way of the new structure. Picking up the elevated columns, supporting them while the old foundations are removed and the subway is constructed beneath, and then transferring the column load to new foundations, often on the subway roof, all without interfering with elevated traffic, are operations handled with much ingenuity and skill by the engineers and contractors in charge. One of the most difficult pieces of elevated underpinning on the entire 55 miles of new construction was encountered at Queens Plaza and along Northern Boulevard, Long Island City, where the new subway runs far beneath a maze of single- and double-deck elevated lines radiating from a terminal station. The following article tells how the underpinning work was handled on this section. Previous articles appearing in this series on New York subway construction were published Aug. 7, 1930, p. 200; Sept. 4, 1930, p. 371; Sept. 18, 1930, p. 455; Nov. 20, 1930, p. 796; Jan. 26, 1931, p. 136; Dec. 24, 1931, p. 1,000; and March 31, 1932, p. 471. —Editor.

THE SUPPORTING of columns of existing elevated rapid-transit lines was a major problem in the construction of section 1, route 108, of New York's new independent subway system, under Queens Plaza and Northern Boulevard, Queensborough. The elevated structure at Queens Plaza, at the end of Queensborough Bride, is both a through and a terminal station, with lines radiating in all directions, some of which are arranged in two tiers, one above the other. In the construction of the new subway crossing under the maze of overhead tracks some of the elevated columns were to be supported on the roof of the new subway; others that were outside the finished line of the subway but within the influence line of the subway cut had to be maintained or underpinned; while still others had to be supported on new columns, the foundations of which were to be at the outside walls of the new subway.

While these various conditions required different methods of procedure, it was necessary at all times to proceed with utmost caution so as not to endanger the safety of the overhead structure or to interfere in the slightest degree with heavy traffic on the elevated lines. In the installations requiring new columns, falling on the outside walls of the subway, a novel procedure was adopted by the contractor in the use of cantilever trusses for supporting the elevated structure while the old columns were removed and new ones installed, one at a time.

In the section extending from 31st St. to 41st Ave., along Northern Boulevard, the elevated structure above street level was supported on two-bent towers, having in general two roadway columns and two sidewalk columns in each bent, except for a few bents that had two roadway columns only. In general, the bents consisted of four columns carrying a light cross-girder and braced by swaybracing of angle irons. The two bents of the towers were connected by cross-struts and diagonal bracing.

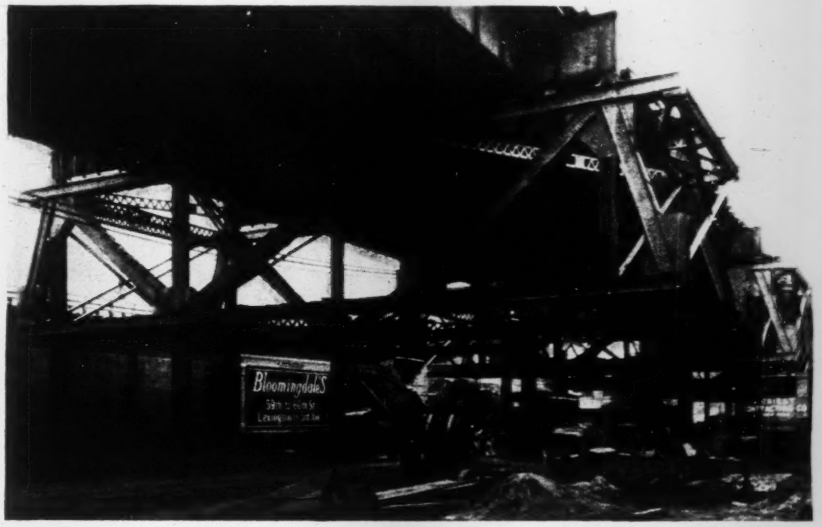


Fig. 1—Addition of steel trusses to elevated railroad bents permits structure to be carried on two columns instead of four. Trusses act as cantilever while outside columns are removed and replaced with heavier posts on new foundations.

The reconstruction plans called for the removal of the existing columns and supporting the elevated structure on two new columns set outside the old columns, the foundations of which formed a part of the subway walls and extended below subgrade of the subway. As shown in Fig. 2, the new supporting columns came so close to the two old sidewalk columns that to build a new footing it was necessary first to underpin the old outside columns and remove their footings. The contract called for the removal of existing columns and the transferring of the elevated load to the new sidewalk columns by means of steel trusses or girders riveted to the existing columns.

Fortunately, most of the existing columns rested on concrete piles, extending to about the subgrade of the new subway, and advantage was taken of this condition. The steel trusses were riveted to the elevated columns first, and the new tower bracing was placed so that towers of the elevated structure were well braced. Provision was made, however, for attaching the new columns to the trusses later. The object of this procedure was to support the existing sidewalk elevated column by means of the new steel truss acting as a cantilever (Fig. 1), thereby bringing its load on the footing of the roadway column immediately adjacent to it. The existing piles of the roadway columns were sufficiently capable of taking the additional load coming on them from the cantilever action, with no observed settlement during the construction procedure. This arrangement permitted the removal of the outside column and the installation of the new column without the necessity of underpinning the outside column.

To insure perfect safety to the elevated structure, only one column in a tower was attacked at a time. When this was finished, another, diagonally opposite, was started. As soon as the new column footing was finished, the new steel column was set and bolted to the steel truss, but it was not grouted. When the new footings of the tower were finished and the new steel columns riveted to the trusses, the two new columns were jacked against their foundations sufficiently to raise slightly the existing roadway column bases off their respective footings. This made

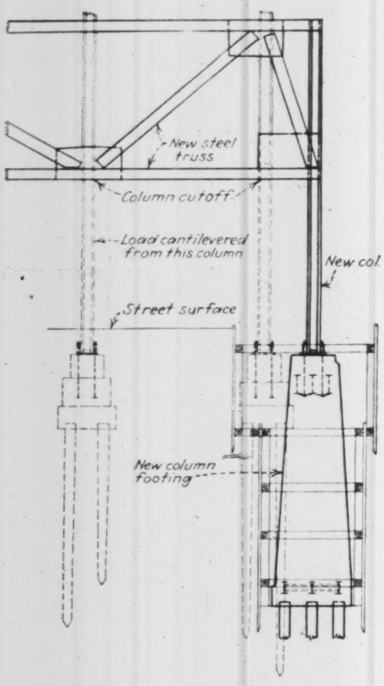

New steel truss
Column cutoff
Load cantilevered from this column
New col.
Street surface
New column footing

Fig. 2—Two new columns and steel trusses eliminate four old columns in each elevated bent. Load is cantilevered out from adjacent roadway column while outside column is replaced with new post.

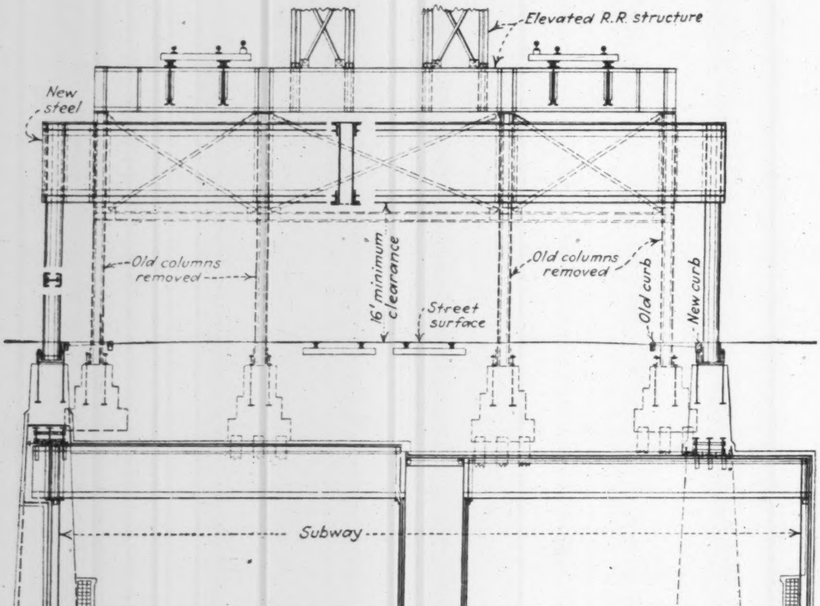
sure that the load was transferred to the new columns, and the existing roadway columns could then be cut and removed.

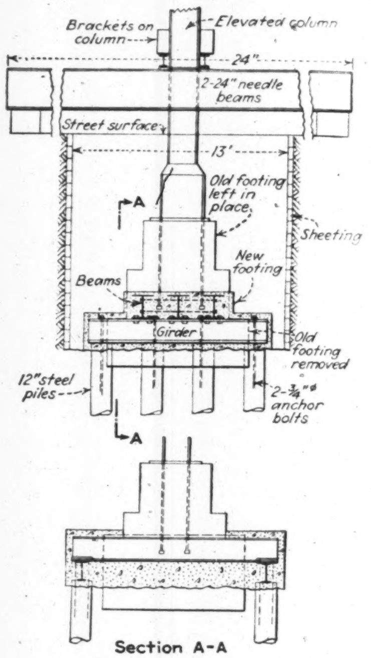
The foundations for the new columns were concrete shafts built within sheeted pits sunk to below subgrade level, sometimes resting on piles. Special care had to be exercised in digging the pits in order that no loss of ground would occur, with the possibility of causing settlement of the existing roadway columns.

The attaching of the steel trusses to the existing columns also presented a rather difficult problem, as the connections of the existing transverse tower bracing and the longitudinal bracing interfered with the new steel. In the case of the transverse tower bracing the difficulty was overcome by removing one side of the connection at a time and attaching one half of the truss. The other side was then removed, and the remaining half of the truss was attached, and then the two were riveted together. To permit the fastening of the longitudinal bracing, temporary bracing had to be installed in such a position that it would not interfere with the new steel. The temporary bracing was placed so as to avoid the existing bracing in case the latter had to be removed, and also to clear the new tower bracing. In special cases, plate girders were used in place of trusses (Fig. 3).

It is believed that the utilization of the steel trusses to aid in the underpinning of the sidewalk columns in this manner is an innovation in elevated underpinning. It is certain that this method has served materially in decreasing the delays and difficulties had the ordinary method of underpinning and supporting been followed.

Fig. 3—Special case where a plate girder was installed under a double-deck section of elevated instead of a truss because of low headroom. Also, in this case, one of new supports comes on the subway roof, while other is part of subway wall.


Elevated R.R. structure
New steel
Old columns removed
16' minimum clearance
Street surface
Old columns removed
Old curb
New curb
Subway
Piles if necessary


Brackets on column
Elevated column
24"
2-24" needle beams
Street surface
13'
Old footing left in place
A
Sheeting
New footing
Beams
Girder
Old footing removed
12" steel piles
2-¾"ø anchor bolts
A

Section A-A

Fig. 4—Permanent pipe-pile foundations for isolated elevated columns outside of subway structure but falling within influence of subway cut. Needle beams at street level, as shown, were used in most instances for temporary column support, and old footing was cut loose for installation of new foundation grillage. Occasionally no temporary supports were used, and in such cases top grillage beams were installed in slots cut through old footing one at a time.

The steel bents described herein existed on only part of the elevated structure to be underpinned. There were numerous single and isolated elevated columns that were underpinned and handled by two other methods.

In the case of single columns located off the finished subway structure but within the influence lines of the cut, pipe piles were driven outside the existing column footing to provide new permanent foundations. These columns were shored, the footings removed and the new footing formed amid the new grillage and capping. At first the shoring of the column before driving the pipe piles was not contemplated but it was found that the driving of the piles dragged the ground down sufficiently to cause the columns to settle. To avoid this settlement and thus have the columns always under control, in some cases steel brackets were attached to the column, and needle beams placed on wood blocks were set under the brackets (Fig. 4). The settlement of the footing while driving the piles would cause the transfer of load from the footing to the needle beams without wedging or jacking. With the load resting on the needles, the old column footing was removed and the new footing was built. The column load was then transferred to the new foundation.

In some cases the settlement of the

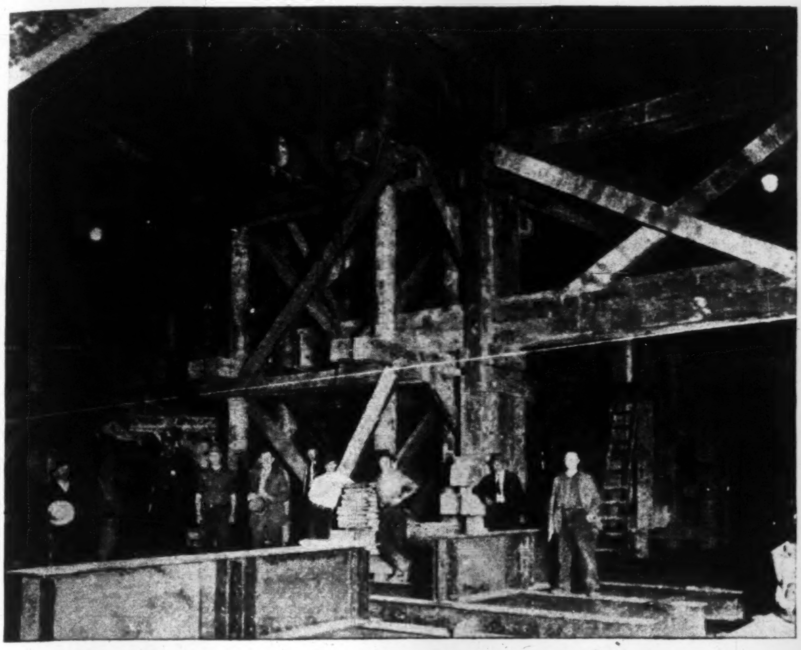


Fig. 5—Temporary pipe-line underpinning extending through subway cut for support of columns later to be carried on subway roof. Wood trusses shown are part of trench-sheeting bracing.

columns produced by the driving of the piles was taken up by wedging between the botton of the steel base plate and the top of the existing footing, eliminating the use of additional shoring beams. The load was then transferred to the pipe piles by means of grillage beams, as shown in Fig. 4, the beams being placed through slots cut out of the old footings.

Temporary underpinning was required for these columns, which were to rest ultimately on top of the new subway roof. Steel pipe piles were driven below future subgrades for these temporary supports. During the driving of the piles it was necessary in some cases to shore up the columns to prevent them from settling, although in most cases settlement was taken care of by driving wedges between the column bases and the top footing, depending upon the load to be carried. The piles were blown out with compressed air and filled with concrete. Timber swaybracing to tie the piles together into rigid towers was placed as the subway excavation progressed downward (Figs. 5 and 6).

The columns were picked up with needle beams attached to brackets fastened to the columns while the old footings were removed and steel caps were placed across the towers. The columns were then let down on the pile supports.

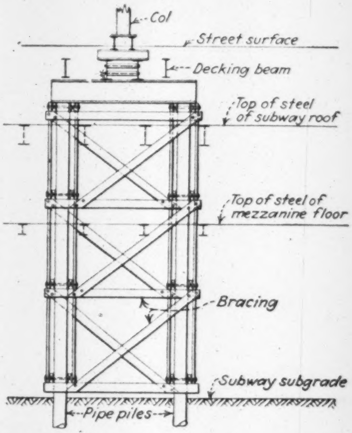


Fig. 6—Details of pipe-pile towers for temporary support of columns later to be carried on subway roof.

All of the underpinning work was done before the street decking was placed and before general excavation commenced. The pile towers were carefully located so as not to interfere with decking supports, excavation timber bracing or the new subway steel. The decking was carried on independent supports to prevent any settlement affecting the column supports. After the excavation had been completed and the steel erected, new concrete-column footings were built on the roof and the column load was transferred from the pipe piles to the permanent support by means of hydraulic jacks.

Personnel

The new subway system is being built by the New York board of transportation under the direction of Robert Ridgway, chief engineer, and John R. Slattery, deputy chief engineer in charge of construction. John H. Meyers, division engineer, is in charge of the work in Queensborough and northern Manhattan. The board of transportation and the Interborough Rapid Transit Co., through Mr. Pegram and his assistants, Mr. Gardiner and Mr. Jargenson, offered valuable suggestions. The W. G. T. Construction Co. was the contractor, with W. G. Triest, president, and E. W. Robinson, vice-president, taking a very active part in the conduct of the work together with John L. Hogan, chief engineer. The firm of Frederic R. Harris, Inc., was the consulting engineer. Frederic R. Harris is president, and A. F. Lipari vice-president.

* * *

Soundproof Partitions

THE ACOUSTIC laboratory of the U. S. Bureau of Standards has recently made sound-transmission measurements on a set of four wall panels constructed of cinder block and clay tile. The panels, all of which were 4 in. thick, included: (1) standard Straub hollow cinder-block partition tile 4x8x18 in., weighing 29.7 lb. per sq. ft.; (2) New Jersey porous hollow clay partition tile, 4x12x12 in., weighing 27.5 lb. per sq.ft.; (3) New Jersey hollow clay tile 4x12x12 in., with 1-in. shells, weighing 37.5 lb. per sq.ft.; and (4) New Jersey standard clay partition tile 4x12x12 in., weighing 33.4 lb. per sq. ft. The mortar was composed of one part portland cement, one part of lime and five parts of sand by volume. The panels were plastered on both sides with a ⅝-in. coat of gypsum plaster and a white finish coat.

The results of the sound-transmission measurements are given in the accompanying table:

SOUND TRANSMISSION COMPARISON

Frequency Band Cycles Per Second	Reduction Factor (In Decibels) Panel No. 1	Panel No. 2	Panel No. 3	Panel No. 4
118 to 138	30	31	30	33
241 to 271	30	31	35	33
486 to 538	38	36	44	42
977 to 1,071	48	47	52	46
1,956 to 2,140	53	50	56	49
3,961 to 4,231	59	58	65	62
Average	43	42	47	44

The reduction factors are given in decibels, as the results are thereby expressed in numbers that are approximately proportional to the loudness of a sound as heard by the ear. The larger the reduction factor the better the sound insulation of the panel.

One decibel is practicially equivalent to the smallest change in intensity that the average ear can detect. Because of the smallness of this unit a difference of less than 5 decibels is of no practical importance. It will be noticed that the average reduction factors for the panels measured differ by not more than 5 decibels. The total reduction factor of, say, 45 decibels should be sufficient to reduce ordinary conversation to inaudibility.

Hyperbola Is Best Street-Crown Curve

Computations for applying hyperbolic crown curve: (1) to normal street section and (2) to unsymmetrical street sections

By M. W. Furr
Professor of Civil Engineering, Kansas State College, Manhattan, Kan.

THE SUBJECT of the design of street crowns has been given so much consideration by municipal engineers and the technical press that further effort to simplify and perhaps standardize the work or to develop a better form of section seems imprudent. However, it is believed that the following explanation and comparison will prove to be interesting and useful. A good bibliography on the subject is found in *Engineering News-Record* of April 5, 1923, p. 627; July 28, 1927, p. 152; Sept. 15, 1927, p. 443; Nov. 24, 1927, p. 850; Jan. 7, 1932, p. 31; and Jan. 7, 1932, p. 29.

There are a few aspects of the problem that should be regarded further. For instance, in the "Construction of Roads and Pavements," by T. R. Agg, fourth edition, p. 121, it is pointed out that "the parabolic form of crown is generally satisfactory, but it has been criticised in certain instances because the central portion is too flat." Consequently, "Some designers prefer to use a form of curve that will give a greater cross-slope in the central part of the street." In addition, it is realized that the local conditions usually have an influence on the choice of method to be used in the design. It seems, with the present traffic requirements in mind, that the tendency in the design of street crowns is to reduce the total crown (over that given by early rules) and to sharpen the cross-slope of the pavement in the center of the street to afford better drainage. This particular requirement, obviously, is not obtained by the use of an ellipse (*ENR*, Jan. 7, 1932: "Elliptic Cross-Sections for Pavement," by John R. Jahn).

It is the contention of the writer that a rectangular hyperbola is the form of curve that more nearly satisfies the general requirements of crown sections for streets, although the elliptic section may be better in arid regions where too much cross-slope is undesirable. The hyperbola has all of the advantages of the other forms of crown sections used, except that it is at variance with the elliptic arc worked out by Mr. Jahn. The hyperbolic form of crown, moreover, is relatively simple to lay out and check in field practice; and it will not be found any more difficult to make a suitable connection with any special form of combined curb and gutter that is necessary to use. The solution of the hyperbolic curve is as follows, considering first the general case, or that of the normal street section.

Normal street section

The equation of a conic section is derived to pass through the five points *A, D, G, K* and *Q* of Fig. 1. The coordinates of the points *A, D, K* and *Q* are referred to point *G* as the origin and are expressed in terms of the total crown, *c*, and the width of the pavement, *W*, from face to face of curbing, points *D* and *K* being located at the quarter-point of the street or half-way between the crown-point *G* (the center line of the street in this case), and the gutter-points *A* and *Q*. In order to make the general equation of the conic section flexible, a modulus, *m*, is introduced. That is, *y* at the quarter-point is fixed, within the limiting values for an hyperbola, to be a desirable proportional part of the crown *c*. If *y* equals one-third of *c*, *m* equals 3; or when *y* equals 0.375*c*, *m* equals 2.666, etc. When *m* is fixed as 2 the conic section becomes two straight lines, and when *m* equals 4 the conic-section equation is that of a parabola. In other words, when the value of *m* is less than 2 or more than 4, the fundamental equation is that of an ellipse. Otherwise, the fundamental equation varies from two straight lines through the hyperbolic range to the parabola and thence becomes an ellipse. To illustrate, let *m* = 3, then *y* becomes:

$$\left.\begin{array}{lll} \text{For} & x=\text{zero}, & y=\text{zero} \\ & x=\tfrac{1}{4}\text{ of }\dfrac{W}{2}, & y=0.095c \\ & x=\tfrac{1}{2}\text{ of }\dfrac{W}{2}, & y=0.333c \\ & x=\tfrac{3}{4}\text{ of }\dfrac{W}{2}, & y=0.648c \\ & x=\dfrac{W}{2}, & y=1.0c \end{array}\right] \ldots\ldots(1)$$

For *y* at any distance *x* from the center line of the street:

$$y=\frac{c}{6}\left[-5+\sqrt{25+\frac{384\,x^2}{W^2}}\right]\ldots\ldots(2)$$

and for *m* equal 8, *y* at any distance *x* from the center line becomes

$$y=\frac{c}{16}\left[15-\sqrt{225-\frac{896\,x^2}{W^2}}\right]\ldots(3)$$

Estimating the axes used in the ex gerated example by Mr. Jahn, t elliptic section proposed may be a proximately checked by use of eq tion (3).

Equation (4), given by Prof. E. Cary (*ENR*, Nov. 24, 1927, p. 850), recommended for the calculation of t crown. Where

$$c=\frac{W}{2000}(25-P)\ldots\ldots\ldots\ldots$$

the total crown, *W*, is the width of t street, and *P* is the longitudinal gra in per cent.

The table on p. 657 gives the coeff cients for calculating the crown drop the quarter-points of one-half the stre

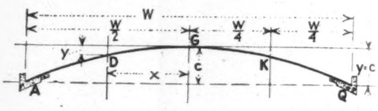


Fig. 1—Normal section with regular curve.

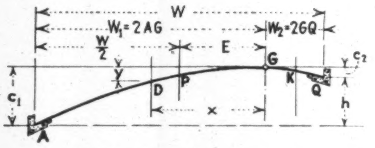


Fig. 2—Unsymmetrical section with separate curves of equal slope.

The characteristics of the different forms of curves are thus differentiated, and it is evident that this method of designing crown-sections has a very broad application. The modified parabola or method by second differences, referred to in the bibliography, also falls within the scope of this exposition of the problem.

Unsymmetrical streets

The foregoing hyperbolic-curve principle is applicable to the design of an unsymmetrical street section as a second case, with equation (2) as a basis when *m* = 3. One of two assumptions must be made in a study of this problem: (1) The mean transverse slope from the crown line, *G* of Fig. 2, to each gutter may be made identical, in which case the crown section will be a compound arc; or, (2) the mean transverse slope each way from the crown line may be assumed so that the hyperbolic arc is unbroken at the crown point *G*. The second assumption is more or less impracticable, as sufficient transverse slope cannot be obtained to the high gutter. This will be illustrated later.

Let *s* equal the mean transverse slope, in per cent of *AG* and *GQ* in Fig. 2. As explained by F. S. Besson in "City Pavements," the rise from *A* to *G* is greater by the amount of additional elevation *h* of the higher gutter than the drop from *G* to *Q*; consequently the horizontal distance from *A* to *G* is

COEFFICIENTS TO DETERMINE THE CROWN-DROP

Crown Section Index, m	Coefficients for Position From Crown Center to Gutter					Remarks
	Crown Point	$x=w/8$	$x=w/4$	$x=3w/8$	$x=w/2$	
2	Zero	0.2500	0.5000	0.7500	Unity	Tangents
2.666	Zero	0.1180	0.3750	0.6788	Unity	Hyperbola
3	Zero	0.0946	0.3333	0.6480	Unity	Hyperbola
4	Zero	0.0625	0.2500	0.5625	Unity	Parabola
8	Zero	0.0296	0.1250	0.3156	Unity	Ellipse

greater than the horizontal distance from G to Q by the amount of $100h$ divided by s. The first assumption stated above is complied with in this method of obtaining the variables. Thence

$$2\,GQ+\frac{100h}{s}=W \qquad (5)$$

Usually s and W are known. The horizontal distance GQ may be assumed and the height h calculated, or vice versa. Distance GQ should be about one-fourth of W. For this particular case, by hypothesis, and using equation (4) to obtain the crown:

$$s=0.10\,(25-P) \qquad (6)$$

$$E=PG=\frac{W}{2}-GQ \qquad (7)$$

and

$$h=\frac{2\,Es}{100} \qquad (8)$$

The maximum value of h is $2c$ for a pavement W feet wide. For example, let $W = 80$ ft. and $P = 0.0$ per cent. Assume $GQ = 16$ ft. By equation (6) $s = 2.50$ per cent. By equations (5) and (7) $h = 1.20$ ft. and $E = 24$ ft. For check by equation (8) $h = 1.20$ ft.

$$c \text{ for } W = 80 = \frac{80\times25}{2000} = 1.00 \text{ ft.}$$

$$c_2 \text{ for } W_2 = 32 = \frac{32\times25}{2000} = 0.40 \text{ ft.}$$

$$c_1 \text{ for } W_1 = 128 = \frac{128\times25}{2000} = 1.60 \text{ ft.}$$

Maximum $h = 2c = 2 \times 1 = 2.00 = 0.40 + 1.60 = 2.00$ ft. The crown drop at K, 8 ft. right of G = one-third of $c_2 = 0.13$. The crown drop at a point 8 ft. left of $G = 0.04$.

This method is satisfactory in use but does not have any special merit over the one given in *Engineering News-Record*, Jan. 7, 1932, p. 29, by Homer A. Humphrey. The foregoing example is only for a hyperbolic arc with a crown-section index of three.

If a regular parabolic arc is passed through points A and G of the foregoing example, h would be 1.50 ft. This would leave only 0.10 ft. for the crown of the street from G to Q. Likewise, for a regular hyperbola, h would equal 1.45 ft. The crown from G to Q of 0.15 ft. would probably suffice, but usually separate arcs from G to the gutters will result in a better design.

Railway Tunnel-Lining Methods Reviewed

DIVERSE PRACTICE of 26 American railways and four foreign railways in the lining, relining and care of tunnels was included in a report presented by the committee on masonry at the recent annual meeting of the American Railway Engineering Association. A condensed summary of the information presented in the report is given below. The diversity of practice is due largely to local conditions.

Kind of Lining—Of the 30 railroads 21 use concrete; one uses concrete block or concrete, one uses concrete walls with brick arches, two use brick and stone, and five use brick. Two English roads use brick exclusively, a French road uses brick and stone, and a Swiss road uses concrete blocks or concrete. In this country and Canada it is general practice to use concrete both in new construction and in the lining of existing tunnels. As a rule, the concrete is mixed near the portal, hauled into the tunnel in dump buckets on a high car and chuted into the side walls. Arch concrete is placed with pneumatic apparatus. In some cases concrete in the walls and arch is delivered in place through a pipe from a pneumatic apparatus at the concrete mixing plant.

Special Facing—Seven roads apply a brick facing to the walls and arch, four roads face the arch only; two use vitrified brick, one cement plaster and one iron-oxide. The English roads use a hard blue brick for both walls and arch, while the French road uses cement plaster on the upper part of the arch.

Seepage—Waterproofing is not usual, but membrane waterproofing and hydrated lime in the concrete have been used successfully to prevent seepage. The Swiss railway system has used asphalt and lead plates over the arch. Grouting, cement-gun work, quick-hardening cement and concrete placed under pressure have also been used. Tile drains behind the lining have been found successful on six roads and unsuccessful on another road.

Removal of Timber—In new construction thirteen railroads remove all temporary timbering, where the formation permits this; twelve leave the timber in place partly incased with the permanent lining. In the relining of old tunnels the timbering is usually removed to provide the required clearance, temporary timbering being installed during the work. On European railways the general practice is to remove all timber in both new construction and new lining.

Packing—To fill the voids due to overbreakage, thirteen roads increase the section of lining to include these spaces at the springing line and haunches of the arch, in preference to the use of dry packing. But eleven roads do not increase the section. In Europe the general practice is to increase the thickness to include all overbreakage. For dry packing, rock is most generally used; sand, earth and wood are used to some extent, with brick in England. In a few cases dry sand or gravel is placed by pneumatic apparatus.

Expansion Joints—These are rarely used either here or abroad, but construction joints are generally 20 to 50 ft. apart. One railway in this country installs expansion joints of asphalt mastic at intervals of 20 ft.; another places tar-paper joints 50 ft. apart, and a third uses tar paper and elastic filler at intervals of 30 to 40 ft.

Concrete Inverts—While sixteen roads (three foreign) use inverts, twelve do not use them. One road reported that a concrete floor without ballast was installed in 1909, but it failed and was discarded in 1925.

Drainage—On 22 roads that provide drainage, concrete gutters or pipes along the side walls are used extensively, although a few roads prefer central drains. Five roads do not provide drains in tunnels.

Disintegration of Lining—This appears to be rare with any material, except in the case of old tunnels where the original concrete or brick was of poor quality. Erosion due to the blast from the locomotives is more general, especially with low headroom. Chemical action due to the smoke and gas is troublesome in certain cases, particularly where seepage occurs. Freezing and thawing have little effect, except near the portals of some tunnels. On fifteen roads, reinforced concrete placed by the cement-gun method has been used to repair or surface concrete and brick linings and unlined rock surface.

Tunnel Inspection—Regular inspections are made monthly, quarterly, semi-annually or annually, generally with the aid of tower cars and men equipped with sounding bars, tapping hammers and other special tools. In addition, there are the daily trips of the track-walkers and section forces. In one case unlined tunnels are examined weekly by the tunnel inspector with a special car.

Ductility to the Fore at Welding Meeting

Annual convention of American Welding Society in New York reveals divergent views on amount of ductility required and its relative importance—Structural welding committee inaugurates new test program centering on welding of flame-cut edges

AMONG the numerous papers presented at the American Welding Society convention in New York City April 27-29, 1932, a group centering on ductility as a weld characteristic was outstanding. The structural steel welding committee, which recently published results of its five-year test program, approved a supplementary program to begin immediately in which the welding of flame-cut edges is the central element. Frank P. McKibben was elected president and A. E. Gaynor, of the John A. Roebling's Sons Co., senior vice-president of the society. Prof. McKibben, for his "meritorious achievements" in the field of structural welding, was awarded the Samuel Wylie Miller medal, which will be formally presented at the next meeting of the society which will be in Buffalo.

Structural steel welding

Following publication last fall of the results of the five-year test program, the structural steel welding committee appointed a subcommittee comprising O. E. Hovey, F. P. McKibben and H. H. Moss to study the possibilities of a continuing program and the nature of such a program. Appended to the original report were ten suggested fields for further research, and of these the subcommittee has chosen three—slot welds, welding on flame-cut edges and welding on other than structural grade steel for buildings which was used in the first test program—upon which work is to start immediately. The important subject of welds under impact and variable stresses was not included for present investigation due both to the cost involved and to the fact that the fundamental data and equipment for such a series of tests are not available. The subcommittee, however, is continuing its study of this subject. O. E. Hovey, who presented the subcommittee's recommendations, indicated that the variable stress tests would probably be given preference over straight impact because of their much greater practical importance.

Mr. Hovey recommended that the structural steel welding committee adopt for immediate prosecution the following: tests of welding on flame-cut edges of (1) open-hearth structural grade steel specimens, (2) copper-bearing structural steel specimens, and (3) structural silicon steel specimens; and (4) an investigation of slot-welded specimens. Half of the specimens, which total 430, will be made by the gas process and half by the electric-arc process. In the slot-weld specimens some will have the narrow and difficult-to-make ½-in. slot, some will have V-notch slots with both sharp and rounded corners and some will utilize 1¼-in. slots in which two fillet welds can be placed. Multiple-slotted specimens are also contemplated. The committee voted $4,000 to carry out the work.

Weld stress theory

Of the numerous papers on the program, the conclusions of only a few can be mentioned. Leon C. Bibber, bureau of construction and repair, Navy Department, presented experimental results checking closely the theoretical method he previously proposed (*ENR*, May 1, 1930, p. 727) for calculating stresses in fillet welds. From his theory and his tests he reasons that the throat of a standard fillet weld is subjected to pure tension acting perpendicular to the throat and that the intensity of this stress is twice that in the base metal.

Welding wrought iron

Superior welding quality has been a recognized feature of wrought iron since earliest history, said James Aston (A. M. Byers Co.) in a paper on the subject of wrought-iron welding. This reputation has been gained for the most part in welding wrought iron with the plastic processes. However, recent experience is indicating that fusion welds may also be made with entire satisfaction. The material has a high base purity and the ferrous silicate slag in wrought iron provides a beneficial self-fluxing action for fusion welding. In general, greater heat should be used in welding wrought iron than steel. Low-carbon rod is best. Also, a puddle of molten metal should be maintained at the point where the rod is being applied, the end of the rod being kept immersed in this puddle until enough metal has been deposited. Then the edges of the molten puddle and the surrounding colder metal should be fused together to obtain a solid union. Care should be taken to add no metal except through the vehicle of the molten puddle. Excessive agitation of the molten pool should be avoided to eliminate oxidation. and some machine parts. W. B. Mil

In reply to a question as to corrosion loss from welding, Dr. Aston admitted this to be so but stated that the use of soft iron or steel rods reduces electrolytic action between weld and base metal to a minimum. He pointed out that threading of wrought-iron pipe is also damaging to corrosion resistance, probably more so than a weld would be.

Ductility in welds

Weld ductility was considered in a group of papers whose presentation occupied a full session. The subject has recently been brought into prominence by publication of a code for fusion welding of unfired pressure vessels by the A.S.M.E. in which great emphasis is laid upon the importance of weld ductility. The data presented were of primary interest to the welding expert, but the points of view expressed may have a bearing on structural welding when and if joints carrying variable stresses and impact are considered.

Complete sympathy with extreme ductility was apparent in the paper by E. R. Fish (Hartford Steam Boiler Inspection & Insurance Co.), who sees in it a means of minimizing the adverse effects of high localized stresses due to temperature differentials ("fabricating stresses") that have caused some pressure vessel failures. This point of view was in a measure supported by a series of test results presented by D. Rosenthal, professor in Brussels University, Belgium, in which ductility of the weld metal was held to prevent overstressing, not only from shrinkage but also from applied loads in service. Although giving no quantitative measure of the necessary ductility, Prof. Rosenthal stated that it should "be as high as possible in both parent and deposited metals." H. E. Rockefeller (Linde Air Products Co.) in a discussion of Mr. Fish's paper felt that too much ductility was being urged, pointing out that, for high-temperature service, high yield point and low ductility steel has always been regarded as best. While ductility is important in relieving fabricating stresses, Mr. Rockefeller believed it possible by proper design and technique to take care of expansion and contraction stresses satisfactorily even when using non-ductile weld metal.

A paper by Prof. H. F. Moore (University of Illinois) discussed a new and necessary characteristic of some metals which he termed "crackless plasticity" or the ability under repeated stress to resist spreading of cracks which may originate at minute defects. Metals such as duralumin may be quite ductile but are nevertheless "tender" and have low crackless plasticity. So, Prof. Moore concludes, weld metal and base metal should have ordinary ductility to withstand steady loads and strains of erection, but they should also have crackless plasticity when used in pressure vessels, tall buildings, railway structures

(Union Carbide & Carbon Co.) pointed out that crackless plasticity is probably a universally good weld characteristic, since all weld metal contains pores from which cracks might spread.

The need of fewer opinions about ductility and more research and analysis was the topic of a paper by Prof. C. A. Adams (Harvard University). Confining his remarks "to those phases of the subject about which we know at least a little," Prof. Adams stated that "ductility undoubtedly plays an important part in vessels pierced by openings of various sizes." Also for many types of structures high ductility is not essential, if the material between the joint is ductile and if the weld itself is homogeneous and free from defects. In so far as locked-up stresses are concerned, Prof. Adams stated that we do not know enough to state positively that a ductility of 15 per cent as measured by bend tests is not sufficient, although we are pretty sure that a ductility of 10 per cent or less is unsafe for many structures.

"Ductility greater than the parent metal would ruin welding," said C. J. Holslag (Electric Arc Cutting & Welding Co.), who went on to state his belief that fortunately because of the inherent porosity of welds they could never be made as ductile as rolled steel. Also because the yield point of weld metal is always higher than the yield point of the parent metal, strains will be concentrated on the latter, making weld ductility relatively unimportant. Enough ductility (up to about 20 per cent), however, should be provided to withstand welding contracting strains, concluded Mr. Holslag.

Ductility in line pipe

In welding overland pipe lines for gas and oil considerable experience with weld ductility has been gained. T. W. Greene (Linde Air Products Co.) in a paper on the subject stated that from 10 to 12 per cent is a minimum requirement of weld ductility, since these values represent the stretching that occurs in the outer fibers in bending a 2-in. pipe 90 deg. If a weld has the requisite properties of strength and quality to withstand such bending, Mr. Greene reasons that ductility higher than these values is not required or desirable. The major portion of Mr. Greene's paper was devoted to the presentation of test and experience data showing that the quality of weld is of much more importance than mere ductility. The strength of the weld metal should be at least equivalent to that of the base material and the weld should be free from imperfections.

C. L. Waddell (Worthington Pump & Machinery Corp.) also pointed out in his paper that while both tensile strength and ductility are important characteristics of welds, the relative importance of all physical characteristics of welds is not subject to a fixed rule but depends entirely on the type of service that the weld is called upon to withstand. Test procedures to determine the physical characteristics of welds are numerous, but Mr. Waddell favors the nick-break test and the etched sample test. On a series of tests that he recently carried out, Mr. Waddell came to the following conclusions, among others, regarding ductility in welds: (1) Ductility decreases with increased carbon content; (2) ductility decreases with increased tensile strength in welds free from defects; (3) application of beads in rapid succession and use of high welding current refines grain structure and increases ductility; (4) hot peening increases ductility; (5) defects on the surface of corners cause free bend test coupons to show low ductility. Mr. Waddell believes that the greatest strides in the welding industry have been made since it was possible to produce ductile welds, but that nevertheless ductility is not a panacea for all the evils of welded construction. Good engineering based on complete knowledge of the conditions of service is the basic criterion. Mr. Waddell stated that the most startling discovery of his entire study was the slight difference in cost of welding with bare and covered electrodes. Electrodes adopted as standard by Mr. Waddell's company are bare electrodes showing 58,100 lb. per sq.in. tensile strength and 19.37 per cent elongation in ½ in. and a covered electrode showing 61,650 lb. per sq.in. tensile strength and 54 per cent elongation in ½ in.

E. Chapman (Lukenweld, Inc.) stated that good welds require high strength, high yield point, high fatigue limits and clean steel, the latter being synonymous with ductility. C. H. Jennings (Westinghouse Electric & Mfg. Co.) presented a paper discussing various methods of determining weld ductility in which he showed the important effect of shape of test specimens and gage lengths upon the per cent elongation secured. Regarding tensile and bend testing methods, there seems to be no apparent relation between the elongation values obtained. This checks other investigators who have found that bend tests do not measure the same properties of ductility that tensile tests do. Mr. Jennings prefers the tensile test. In a discussion of this paper A. M. Candy (Westinghouse Electric & Mfg. Co.) warned against the use of highly ductile welds where localized stresses might break the parent metal, emphasized that ductility is not a substitute for careful designing, and stated that such applications of welding as machinery bedplates and buildings do not require ductile welds.

Ductility session summary

In a discussion of all of the papers, given at the end of the session, J. H. Critchett, vice-president, Union Carbon & Carbide Research Laboratories, Inc., chose to supplement his own remarks by an analysis of the various viewpoints that had been expressed. Mr. Critchett prefaced his discussion by referring to the views of the late S. W. Miller on ductility which he believes carry the most conviction of any with which he is familiar. Mr. Miller showed that with higher elastic limit and ultimate strength in the weld than in the base metal, stresses would be absorbed in and any adjustments made by the base metal. Mr. Miller also placed more reliance on careful procedure control in designing and making the weld than on any one weld characteristic, including ductility. Mr. Critchett found most of the speakers at this meeting to agree to the same view, Mr. Jennings saying that both strength and ductility are possible of attainment in laboratory welds, Mr. Waddell saying that the same qualities can be had in factory welds, which also need a basis of sound engineering, Mr. Greene pointing out that in actual construction, particularly of overland pipe lines, extreme ductility is not a requisite but that good workmanship is, Prof. Moore agreeing that ductility is a desirable property but admitting that there is available no test for the type of ductility really needed, Prof. Adams agreeing that extreme ductility is not a requisite of sound engineering construction, and Mr. Holslag emphasizing that there is such a thing as too much ductility. Against this unanimity of opinion Mr. Fish and Prof. Rosenthal proposed extreme ductility.

To these viewpoints Mr. Critchett added his own—namely, that the necessary properties of a weld may be arranged in four classifications which in the order of their importance are: (1) Ability to transmit stresses, for which the outstanding requisite is tenacity, followed by high elastic limit and then ultimate strength, with ductility as a minor requirement to allow for irregularities of manufacture and inaccuracy of design; (2) resistance to deterioration in service, requiring resistance to corrosion, to corrosion fatigue, to mechanical fatigue and possibly to shock; (3) ability to withstand accident and abuse, requiring a high factor of safety in the design and ductility; and (4) ease of fabrication, involving such necessary properties as strength, ductility, machinability and others. Ductility thus is a minor factor of the first classification, does not enter into the second and is a major factor only of the third and fourth. Mr. Critchett believes that this analysis agrees with most of the other speakers who took a definite stand—namely, that while ductility is an important element, extreme ductility is not necessary. Mr. Critchett's conclusion is that ductility is a minor element compared with sound design, high-grade materials, careful attention to fabrication and thorough proof testing before use.

Regulation of Motor Transport Is Proposed to Congress

Interstate Commerce Commission completes extensive study of the relation of buses and trucks to rail and water transport and outlines extent to which motor-traffic regulation is immediately desirable

THE amount of federal regulation of the movement of buses and trucks in interstate commerce that is desirable in the interest of improved transportation and the extent to which such regulation should be made effective immediately are outlined in a report on coordination of motor transport recently transmitted to Congress by the Interstate Commerce Commission. Briefly summarized, the commission finds:

(1) That transportation by motor vehicles, buses and trucks over the public highways is within certain distances and in certain respects a superior service, and that the rail and water lines should be encouraged in the use of this instrumentality of commerce whenever such use will promote more efficient operation or improve the public service; (2) that there is substantial competition between rail and water carriers on the one hand, and motor carriers on the other, for the transportation of both passengers and freight, and that this competition is increasing; (3) that such competition is conducted under conditions of inequality, particularly in regard to regulation; (4) that a contributing cause, aside from the general business conditions, of the present unsatisfactory financial conditions of the railroads is the existence of unrestrained competition by rival transportation agencies; (5) that there is today, and probably would be under normal conditions, an excess of carrying capacity of existing transportation facilities; (6) that unrestrained competition is an impossible solution of the present transportation problem and is incompatible with the aim of coordination under regulation; (7) that federal legislation relating to the regulation of motor vehicles operating upon the public highways and engaged in interstate commerce is desirable in the public interest.

Extensive study made

The commission's report is the result of an extensive study of the relation of rail to motor transport, which it has been carrying on for about two years. Public hearings were begun in November, 1930, in St. Louis and were held subsequently at the major transportation centers throughout the entire country. This inquiry, the commission states, was essentially an economic one; that coordination of, and not competition between, rail and highway transportation was the primary theme. Legislation and regulation may be found helpful, but legislation and regulation should be availed of only to assist in the proper development of economic processes, not to protect or restrict unduly either form of transportation. In attempting to set up a basis for evaluating properly the many factors involved, the commission's staff collected a great mass of statistics as to the extent of the operations of the bus and truck companies, their organization, employment conditions, schedules of operation and rates; it also attempted to determine the extent to which buses and trucks have diverted traffic from the railroads and to analyze the traffic so diverted in order to determine what part of it logically should be handled by trucks and buses and what part has been diverted because of unfair or unsound methods of competition or through lack of adequate regulation of motor-vehicle operation. Truck operation studies included, in addition to the "common-carrier" trucks, the operations of "contract carriers." The latter group does not attempt to handle all classes of freight as do the common-carrier rail and truck operators but only certain commodities by direct contract with the shippers.

Another question that the commission went into in considerable detail was a determination of the extent to which the competitors of the railroads benefit disproportionately from public provision of rights-of-way and other transportation facilities. Its findings are set forth in an appendix to the report. From the facts before it the commission was unable to arrive at a conclusive answer. They appear to indicate, however, that: (1) In 1929 direct charges against owners and users of motor vehicles contributed about 75 per cent of the fund currently provided for state highways, 16 per cent of those for county and local roads, and 48.5 per cent of all such funds; (2) the railroads are being increasingly relieved of contributing to funds used for state highway purposes, but they contribute very substantially to those used for county and local roads; highway operators make relatively small contributions to the latter fund.

Truck operations

Summarizing the evidence put forward, the commission states that highway trucking is made up generally of small-scale operators who lack the effective organization and full service and financial responsibility generally required of public service agencies; the industry is, however, functioning with increased effectiveness and is of sufficient age to have demonstrated its inherent aptitudes and limitations.

The trucking industry in 1929 carri approximately 6 per cent as mu freight, measured in ton-miles, as t railroads, and 4 per cent as much as agencies of inland transportation (ra water, pipe line, highway and air); terms of tonnage originated and d regarding the distance transported, it estimated that trucks originated f inter-city movement 14.2 per cent much traffic as did the railroads 1929. Truck competition exerts a larg influence over rail rates and in th aggregate accounts for losses in rail revenue of several hundred millions dollars per year; the movement of som traffic has been due to the advent of th truck, and many small points heretofor without rail service are now served b motors; truck service for many classe of traffic is more complete, more flexibl and more expeditious than rail servic and frequently at lower rates.

Where rail traffic is light, diversion necessarily increases unit cost greatly and imperils the continuance of established services; the alternative is increased transportation charges on traffic not within the effective reach of trucks (such as coal and iron ore), commodities tied to the rails by marketing considerations (such as grain) and all classes of traffic moving long distances.

Field of truck competition

To achieve the maximum benefits of the new facility, consistent with a minimum degree of duplication of service the commission states that it is necessary that rail and motor competition be conducted under an equality of opportunity and that service, which upon comparison of delivery time and rates is found to be a duplication, should be limited within proper bounds. A considerable part of the highway trucking service is rendered at less than compensatory rates and is therefore more or less self-destructive. Such competitive conditions may temporarily benefit some shippers, but, if continued unchecked, are bound to result in permanent injury.

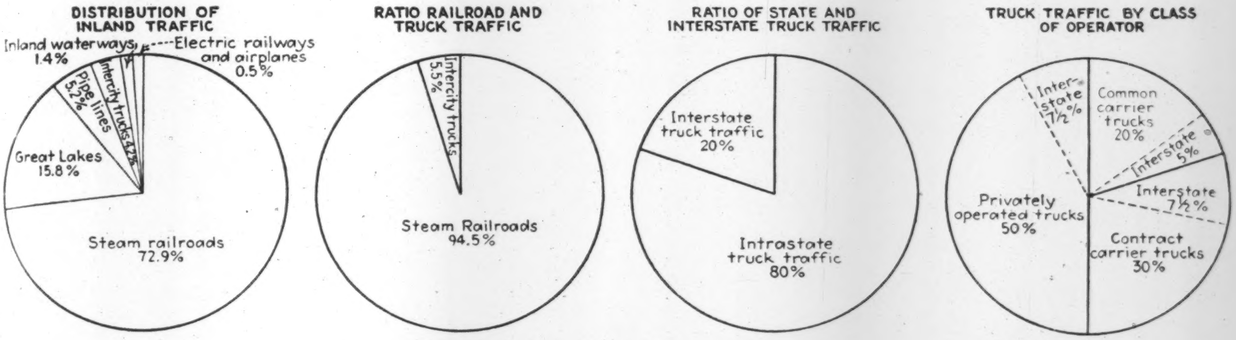
For less than carloads and for much carload traffic, other than bulk movement on a siding-to-siding basis, truck service is so much superior to rail service and truck costs are so far below those of rail or any combination of rail and motor facilities that for distances up to about 150 miles (averaging not more than 75 miles) trucks have a distinct advantage; in an intermediate zone up to about 300 miles, truck service can equal or excel rail service on the foregoing classes of traffic, but line-haul costs of trucks within this zone are greater, so that there are here large possibilities for effective coordination.

The trucking industry is subject to internal competition induced by the ease of entering the industry, the small scale of most operations and by the fact that only 15 per cent of the operators are common carriers. Contract carriers and private operators make up 20 and 65 per cent of the operation, respectively. No plan of rate regulation that does not include within its provisions the contract carrier is thought feasible.

Bus operations

The commission states that the bus industry has attained a greater degree of permanency and a more effective organization than the trucking industry. Consolidation of lines has brought about a considerable number of companies of large scope, but the industry as a whole lacks the full service and financial responsibility desired.

Buses do a larger amount of business relative to that of rail carriers than do trucks. Measured in passenger-miles, buses did about 26 per cent as much business as did the railroads in 1930, and they carried, disregarding the distance transported, 71 per cent as many passengers as did Class I railroads and earned 40 per cent as much gross passenger revenue. A comparison of 1929 with 1923 shows that the railroads have lost $274,000,000 of passenger revenue, and, compared with 1903, they have lost $418,000,000. From 20 to 30 per cent of this loss, the commission states, is attributable to buses, and the remainder mainly to increased use of private cars.



The railroads still carry the great bulk of freight that moves between cities. Freight that moves in trucks is, however, largely of classes that pay high rates. All items shown are in ton-miles.

The effect on unit cost of diversion of passenger traffic is more marked than in the case of diversion of freight traffic, owing to the greater inflexibility of passenger-train service. Railroad passenger traffic as a whole is now conducted at a loss.

Problems of regulation

In discussing its recommendation that a limited amount of regulation be extended to all types of truck operators in interstate commerce, the commission states that regulation, to be effective, should include both contract and common carriers. They should be treated separately because it is no longer open to doubt that, consistent with due process of law, a contract carrier cannot be converted against his will into a common carrier by mere legislative command or be regulated as such. Further, the commission states that it is well settled that the power over commerce among the states conferred upon Congress by the Constitution is complete in itself, extends incidentally to every instrument and agent by which such commerce is carried on, may be exerted to its utmost extent over every part of such commerce and is subject to no limitations save such as are prescribed in the Constitution; and that the remedies proposed are not only appropriate but clearly within the constitutional power of Congress to prescribe.

The commission believes that nothing should be done to suppress new means of transportation that augment and improve the services furnished to the public; regulation should be provided that will minimize injurious consequences by restraining competition within reasonable limits, encouraging desirable coordination between rival forms of transportation and stabilizing rates and financial conditions.

Reviewing the fact that many problems are involved in the regulation of motor vehicles, especially those other than common carriers, the commission considers it desirable "to make haste slowly." Its recommendation to Congress is, therefore, that Congress provide at once to put federal regulation to the test so far as the transportation of passengers by motor buses is concerned. This would provide an organization that would serve as a nucleus for such further steps in motor-vehicle regulation as experience and added information may show desirable and practicable. The commission also recommends that immediate authority be exercised over motor trucks, both the common-carrier and the contract type to the extent necessary to locate those that are operating in interstate commerce and obtain from them such information with regard to their operations as the commission may reasonably require.

Proposed legislation

As regards the regulation of motor buses engaged in the transportation of persons on the public highways in interstate commerce, the commission recommends that there should be required as a prerequisite to operation: (a) certificates of convenience and necessity; and (b) liability insurance or indemnity bonds. Such certificates should be issued as a matter of course to operators in business for a stated length of time prior to the effective date of the regulatory act, provided they comply with all other applicable provisions of the act; that requirements be set up that fares and charges should be just, reasonable and non-prejudicial; that schedules of fares should be published and observed; that a uniform system of accounts should be required, and provision made for filing reports as required by the commission; that brokerage in transportation of passengers for hire by persons not holding a certificate of convenience and necessity should be prohibited. It is further recommended that railroads and water carriers should be specifically authorized to engage in the transportation of both persons and property by motor vehicles in interstate commerce over the public highways, under the provisions of the transportation act.

Transportation of property for hire by motor trucks operating on the public highways in interstate commerce should be subjected by law to reasonable public regulation. Carriers should be divided into two general classes, common-carriers and contract-carriers. No person should be permitted to operate a motor vehicle for transportation of property for hire either as a common-carrier or a contract-carrier over the public highways in interstate commerce without first having secured a permit and, if a common-carrier, liability insurance that will assure adequate protection for loss or damage to cargo and for personal injuries and property damage; if a contract-carrier, a permit and liability insurance to secure the public in case of personal injury or property damage. All motor carriers for hire should be required to keep such records of operation performed by them and make such reports as the commission may reasonably prescribe.

The commission states that it should have jurisdiction to administer these regulations and authority to refer specific matters to joint boards composed of members of state regulatory bodies; also that it should be authorized to avail itself of the cooperation, services, records and facilities of any state.

Working conditions

For the present the commission makes no recommendations regarding qualifications of drivers, hours of service of employees, and the size, length, weight of load and speed of motor vehicles operating for hire in interstate commerce. This is for the reason that states now have a clear right to protect the public safety under their police powers; that in the absence of legislation by Congress, state regulations of this character, if reasonable, are lawful even though they may directly affect interstate commerce; that legislation by Congress would manifest an intention to occupy this field of regulation, and the effect would be to exclude immediately all state legislation upon the subject and to cast upon the government the duty and burden of enforcement.

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Housing Problems Discussed by Architects

Promotion of housing operations and extension of the architect's field are leading subjects at 75th anniversary of American Institute of Architects

HOUSING, taxation, design of public buildings and directions in which architectural work may be extended under the present depressed conditions were discussed by the American Institute of Architects at Washington on April 27-29. The occasion marked the 75th anniversary of the institute's foundation in 1857. A characteristic review of the work accomplished during the 75 years was given at the dinner meeting by Irving K. Pond, of Chicago, who outlined the institute's work not only for the art and its profession but also for the national capital, whose present development under a carefully guided architectural plan is largely credited to the efforts of the institute.

Various related bodies joined in the meeting, among them the city planning division of the American Society of Civil Engineers, the City Planning Institute and the Producers' Council. A special place on the program was given to the successful organization of the Construction League, formed last September in pursuance of a recommendation adopted at the institute's last convention. Francis Lee Stuart, representative of the American Society of Civil Engineers and vice-president of the league, reported on its organization and work.

Housing and site planning

Housing improvement was discussed in detail in a report of the committee on economics of site planning and housing (Frederick Bigger, chairman). The committee concluded that architects should study the economic and financial factors that affect community change and should cooperate with land owners, developers and financial agencies in promoting well-planned housing. The traditional individualistic house building of America was declared to be wasteful, and excessivce subdivision of land a costly handicap. Large-scale building produces the best results at present and probably will for years to come, said the committee, and unified ownership of housing projects gives the greatest protection against deterioration. A major objective is substitution of high-standard housing for slums and blighted areas. Study of the economic processes of community change, to throw light on the fundamentals of this problem, was recommended by the committee.

E. H. Klaber, in discussion, described the unfavorable features of Chicago's development and the defects of much of the housing there, but he added that the city is becoming alive to its housing problem and that the difficulties of improvement are not as extreme as in some other cities. One-third of Chicago's houses, he stated, are two-family flats. The "rotting interiors of blocks" form a major defect of Chicago housing; the difficulty of introducing row houses and a law against ownership by a corporation of more than one building are obstacles to reform.

Harland Bartholomew, of St. Louis, referred to the importance of site planning for small single houses and to the hazardous influence of unlimited city growth on the stability of any housing area. He remarked that the centralized city is the only economic form known and that decentralization is a term not yet well understood.

Henry Wright held that with proper community planning even an area of a few blocks can maintain itself stable, and that technical excellence of plan and design gives an easy advantage over random housing. He minimized the importance of land cost, saying that decorating and house repair usually cost nearly twice as much per room per month as the land charges; yet the architect works hard to put more rooms on the land but does little to make decorating cheaper. Referring to the fact that the long and narrow lot originated in horse-and-buggy days, he said that the great wastes are in land subdivision and that no subdivision should be allowed unless accompanied by a complete building plan and guarantee of building.

Taxation burdens were discussed in a special committee report, presented by W. R. B. Willcox, of Eugene, Ore., which attributed the economic collapse to increase of site values until nothing was left for wages and earnings. The report concluded that "double payment of rent and taxes must cease, a legal stop must be made to private appropriation of public values and public confiscation of private wealth, rent must be collected for government revenue, and all taxation of whatsoever sort must be abolished."

Continued indorsement by the institute of the Small-House Service Bureau was the subject of animated discussion particularly because the bureau proposed to cooperate with a private-home financing company. It was charged that the stock plans of the bureau, often distributed by real estate men and building material dealers, compete with practicing architects and work against good architectural service. Finally the issue was adjusted, pending further study, by making the institute's indorsement contingent on restricting the bureau's service to architects.

Consulting service, rural architectural work and building modernization were leading elements of a symposium on practice of architecture during a depression. D. J. Baum outlined the possibilities in farm buildings and proposed that the institute's chapters cooperate with agricultural colleges to promote good farm-building design. Arthur B. Holmes described the large field open to minor consulting service, in which the architect can serve the building owner as frequently and as cheaply as a doctor serves his client. Merritt Harrison told of the workings of the Muncie modernization and repair campaign, originated by W. E. Price. In this campaign the architect was largely ignored. Mr. Harrison said that, "The sooner we realize that architects are the sales and planning department of the building industry the better it will be for us and the industry."

Federal building design opposed

Opposing federal building design by government bureaus, a committee headed by Louis La Beaume reported its work to have laws passed requiring the engagement of private architects for public building projects (Green-Walsh bill). It opposed the Cochran public works administration bill and the McDuffie economy bill as continuing bureau design. Resolutions adopted by the institute declare that, "The country will benefit by utilizing the services of the ablest architects and engineers in the nation, and that their employment will result in a more living and vital architecture, appropriate to the localities in which our federal buildings are to be erected;" that bureaucratic encroachment on architecture and engineering should be checked, and that speed as well as efficiency will be promoted by allocating projects to private architects and engineers.

A plan for cooperation of the institute with state associations of architects by granting membership in the institute to such associations was discussed and approved. Education and other professional subjects also formed part of the program.

In the course of the meeting two notable addresses were delivered. Robert D. Kohn, retiring president, gave an appraisal of the organization's purposes and achievements and pointed out the direction in which its future is to be found: "As long as we see ourselves as part of a greater world in which our every act counteracts again on hundreds of others and in turn reacts on us—as long as we see our work as architects in its true relation to all other essential functions of modern life and not as a solitary end in itself, so long will we be justified in dreaming our dreams, for in these lie our only hope of salvation."

Paul Mazur, investment banker, in a luncheon address on the trouble with present economic legislation, pointed out the ineffectiveness of the attempted credit expansion. Good-risk business needs the banks less than it did in 1931, he said, and smaller business volume in general requires less commercial credit. The stimulant of demand is necessary to end the depression. A five-day week could create this demand. But more immediate is building and public construction. We are now suffering a loss of 35 billions annually in wasted productivity. The February record of 15 million new building against a 50 million loss by fire and tornado reflects the retrogression in which we are involved. Initiating public works and subsidizing building by loans would accomplish a vast improvement.

Research in Hydrology to Be Undertaken by Nine Committees

RESEARCH into all the major phenomena bearing upon hydrology is to be undertaken by nine permanent committees recently named by the section of hydrology of the American Geophysical Union, according to an announcement of the National Research Council, Washington, D. C. This section is concerned with the study of the waters of the earth from the time they are precipitated upon the surface as rain or snow until they are returned to the atmosphere or are discharged into the ocean. Each committee is to make an annual survey of work in progress in the field of hydrology that it covers and is to maintain contact with the workers in its field. Following is a list of the committees and chairmen, together with brief statements of the field to be covered by each committee:

Committee on Snow—J. E. Church, meteorologist, Nevada Agricultural Experiment Station, and adviser, Nevada Cooperative Snow Surveys, University of Nevada, Reno, Nev. The quantity and distribution of the snowfall, the methods of making snow surveys, the melting and evaporation of the snow and the relation of the snow to runoff and absorption.

Committee on Glaciers—F. E. Matthes, geologist, geologic branch, U. S. Geological Survey, Washington, D. C. The hydrology of existing glaciers, as distinguished from the work and products of ancient glaciers. The committee is to obtain and interpret systematic records of the advance and retreat of glaciers in the United States, including Alaska; also related records of the movement of the ice, weather conditions and the discharge of water from the glaciers.

Committee on Evaporation—G. F. McEwen, oceanographer, Scripps Institution of Oceanography, University of California, La Jolla, Calif. The rate of evaporation from free-water surfaces, the effects of weather and other conditions that influence evaporation and the methods of determining evaporation; also the fluctuations of lakes and their causes.

Committee on Absorption and Transpiration—C. H. Lee, consulting hydraulic engineer, San Francisco, Calif. The absorption of rain, snow, and streamwater into the earth and its penetration to the water table; the discharge of water by evaporation from the soil and by the transpiration of plants; and the effects of intake and discharge on the groundwater levels.

Committee on Runoff—L. K. Sherman, consulting engineer, Randolph-Perkins Co., Chicago, Ill. The quantities of water discharged by the streams and the fluctuations in the rates of discharge; also the geographic, climatic and other conditions that influence the rate of discharge.

Committee on Physics of Soil Moisture—F. J. Veihmeyer, professor of irrigation investigations and practice, College of Agriculture, University of California, Davis, Calif. The molecular forces that control or influence the occurrence and movement of water in the interstices of the soil and rock formations, including the dynamics of soil moisture in land slides, mudflows, subsidences and frost action.

Committee on Underground Water—D. G. Thompson, geologist, water resources branch, U. S. Geological Survey, Washington, D. C. The occurrence, head and movement of the water in the zone of saturation.

Committee on Dynamics of Streams—L. G. Straub, professor of hydraulic engineering, University of Minnesota, Minneapolis, Minn. The laws of flow of water in rivers and smaller streams, the forces that the water exerts, the work that it does in erosion, transportation and deposition, and the relations between the streams and the channels that they occupy.

Committee on Chemistry of Natural Waters—C. S. Scofield, agriculturist in charge, division of Western irrigation agriculture, U. S. Bureau of Plant Industry, Washington, D. C. The chemical composition and chemical work of the natural waters, both above and below the surface; also the relation of the fresh water to the salt water, both above and below the surface.

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Group Unemployment Work for Young Men

A construction-camp system similar to that used in various places in this country was successfully used in Germany last summer, according to our local correspondent. It was designed particularly to meet the needs of young men, of whom a large number have had no work for several years, and it was intended not only to provide for their maintenance but also to sustain and build up their morale. The system is known as volunteer work service. The men are housed in camps out of which they work in small groups on jobs that would be uneconomical or not worth while under ordinary conditions, such as cultivating rough or bad soil, regulating brooks, improving roads and the like.

They were supplied food, clothing and some pocket money. The system is to be extended this season, in the belief that self-sustaining work is fundamental to sound community existence. At present there are more than six million unemployed (1,600,000 from the building trades) who receive government support without rendering service in return, but the dole is believed to be particularly harmful in the case of young people.

A Hand-Labor Road Job Gives Local Employment

IN COMPLETING last year a new road between Tombstone and Bisbee, Ariz., crossing a mountain range in Tombstone canyon, contracts had been let for the work on the western slope, but for about a mile of the eastern section the highway commission authorized construction by force account to provide work for the locally unemployed. The cost was not to exceed $50,000, this being the legal limit for state work on any one job. The work was under the direction of T. S. O'Connell, state highway engineer, and particulars have been given by W. R. Hutchins, district engineer.

Only three men were moved in from the outside: a foreman, a timekeeper and a compressor man. The job was under the supervision of the resident engineer in charge of the contract work on the western slope. A list of unemployed men from Bisbee, Douglas and vicinity, all citizens of Arizona, was furnished the foreman, each man to work a period of two weeks and then be laid off until his turn should come up again for another two weeks. However, a powderman chosen from the local unemployed was kept for the duration of the job, as every foot of this work had to be blasted, and no chances could be taken by changing powdermen. The roadbed width was 28 ft.

After the blasting had been done on a certain section, men with picks, shovels and wheelbarrows handled all the materal that was to be moved a short distance. Rock that was too large to handle by wheelbarrows was moved by stone boats, made of a large piece of sheet iron, usually 4x6 ft., turned up at the end to form a sled, with chains attached, and pulled by small crawler tractors. This completed the short-haul operation.

The next longer haul was with fresno scrapers and small tractors, assisted by a larger tractor that was also used on a grader in finishing the surface. A driver was kept on this latter tractor for the entire job, as it was too expensive a piece of machinery to warrant changing operators every two weeks. Material that had to be moved a longer distance than was economical with wheelbarrows, stone boats and fresnos was left in place temporarily. Later the state-owned power shovel, with an operator and helper, was moved in and handled this excavation with the help of two to five trucks. Some of this material had to be moved ¼ mile and spread out in widening certain portions of the road.

Culverts of corrugated metal pipe were used, with concrete head walls, and there was a reinforced-concrete culvert or bridge with two openings 10x7 ft.

This work was completed at a cost of $37,000. Mr. Hutchins states that if it had been let by contract or if the highway department had moved its power shovel and trucks onto it in the beginning, some little money could have been saved, but only five to fifteen men per day could have been used. By the method described from 40 to 50 men per day were given work; and by changing these every two weeks much needed help was given to a large number of men. Virtually all the major equipment employed was loaned by the state without rental charge.

Letters to the Editor

Large Public Works Program Should Be Handled Properly

Sir—There are measures before Congress at present concerning public works, control and supervision, which should receive little or no attention from a well-informed legislative body. However, there seems to be a certain amount of "effective pressure" being applied by some of the vote-controlling organizations.

Recently there has been an epidemic of undercover men, supposedly agents of the Federation of Labor, working the construction camps engaged in flood control along the Mississippi River. Just what these well-meaning men uncovered has never come to light—that is, if their findings were of material consequence. Some of the reports made by these undercover men are of unfavorable labor conditions in the levee camps. These reports have since been investigated by the United States Engineer Corps and found to be grossly exaggerated. Labor conditions in levee camps are of the highest order and have been since the weeding out of a few irresponsible contractors.

The bills before Congress now are the outcrop of some of the reports made by these agents. In view of the possibility of a mass construction program being enacted, one would think that there must be a political organization whose aim is to get control of this huge expenditure of public money.

There are many public improvements needed now, such as public buildings, inland waterways, navigation and harbor improvements, flood control, hydro-electric dams, and others, that would not only provide work for the unemployed but would contribute to balancing the national budget through the payment of delinquent taxes.

It is the opinion of many that a mass construction program would be the most effective measure thus far devised for the complete readjustment of our national condition. However, the writer believes that such a huge program should by no means be placed in the hands of a commission of political job hunters, as has been recommended to Congress by sponsors of this commission. There would be more work done per dollar expended, more workmen benefited, and above all an enormous field for graft would be eliminated if it were placed under the control of the Corps of Engineers, U. S. Army, which is now in charge of public works to a large extent.

The Federation of Labor would have Congress enact legislation that would give the federation or its subsidiaries power to name the wages to be paid and the working hours for all men engaged in public works. An act of this sort would be unwise from every point of view. First, it would tend to cause the contractor to include all these elaborate requirements in his unit bids, thus defeating the purpose of its sponsors. To date, the organized contractors have not reduced wages for skilled labor materially, and common labor has not been reduced in proportion to other industries. Many contractors are contributing to the relief of unemployed by employing more men than they need, or would need, in normal times.

Granted the immediate enactment of proper legislation for a mass construction program, the general contractors of this country could put an end to the depression.

M. E. DAVIS.

Lake Village, Ark., Chief Engineer,
April 2, 1932. E. F. Powers Construction Co.

A Towing Job Well Done

Sir—In your issue of March 3, p. 337, you give information about the Wellington drydock that was towed from England to New Zealand. May I inform you that the unprecedented tug work has been done by a Dutch undertaker? I think the names of the two tugboats, "Lwarte Lee" and "Witte Lee," may be mentioned with respect. I believe the two captains of the tugboats with their crews think it best if I do not mention their names. Glad I am, however, that the New Zealand population knew how to respect and honor such seamen.

JOHN NUNNIKHOVEN.

Helman, Holland,
March 30, 1932.

NEWS OF THE WEEK

League Advocates Federal Financing Of Public Works

IMMEDIATE resumption and extension of local public-works activities supported by financing through a government corporation was advocated by the policy committee of the Construction League of the United States in a resolution adopted at a meeting held at Washington April 30 under the presidency of Robert D. Kohn, of the American Institute of Architects. The meeting also took action on housing, grade-crossing elimination, gas-line tax diversion, the home-loan discount bank plan, and single-price bidding.

In introducing the subject of public works, Francis Lee Stuart, of the American Society of Civil Engineers, outlined the critical situation arising from unemployment and the paralysis of business and credit. He forecast widespread dependence on direct governmental relief payment if unemployment is not soon reduced. Mt. Stuart's views found general support, and after full discussion of the problems involved the following resolution was passed:

> The Construction League of the United States, impressed with the need for immediate relief of the present distress of private citizens, industry and business, and in order that the need for public doles may be minimized, and recognizing the importance of a sound financial basis of any relief measures, declares that large-scale employment on needed construction work not competitive with private industry is necessary for such relief.
>
> The Construction League of the United States therefore demands prompt action by the federal government to create employment by establishing a government-owned productive reconstruction work corporation, with a suggested capital of one and one-half billion dollars, for the purpose of making loans at cost to states, cities and other public agencies to finance self-supporting and self-amortizing public improvements which will not add to the budget requirements of the federal government. Such loans should be apportioned to rehabilitation of slums and creation of better housing facilities, sanitary improvements, modernization of obsolete public utility plants, and improvement of public transportation facilities. These loans, made on a basis of self-determination by those who must pay their interest and amortization, would assure a broad distribution of employment throughout the country.
>
> The Construction League of the United States recommends and requests that its member organizations individually and in cooperation urge upon Congress passage of a bill for the purpose outlined, and requests that they report back to the league at its next meeting what progress has been accomplished in this direction.

Gas tax for highways

The league voted to support the principle of reserving gas-tax revenue for highway purposes. It favored the home-loan bank bill, and took steps toward cooperating in the formulation of a uniform state law by which large-scale housing operations would be facilitated, especially in connection with slum clearance and the rehabilitation of blighted areas in cities. A committee of delegates of member societies was set up to study cost apportionment in grade-crossing eliminations among the interested parties.

Single-price bidding or the abolition of bid shopping, which had been before previous meetings of the league, was further discussed, and support of the movement was recommended to the member organizations. The subject is now under study by a joint committee.

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Early Returns Indicate Passage of Hetch Hetchy Bond Issue

Incomplete returns from the May 3 election in San Francisco show a vote of two to one in favor of the $6,500,000 Hetch Hetchy bond issue. Passage of this bond issue eliminates the fear of a shutdown on the construction work on the Coast Range tunnels of this system. This is the final bond issue necessary for the completion of construction of the Hetch Hetchy system. Construction of the emergency pipe line which will make Hetch Hetchy water available to the city before the completion of Coast Range tunnels is continuing and is expected to be completed in June.

Eleven Take Examination for Utah Highway Engineer

Eleven applicants took a civil service examination on April 19 for the position of highway engineer for the State of Utah. It was not required that the applicants be graduates of recognized engineering schools but only that they be licensed engineers. For the last eighteen months Charles D. Vail has been acting engineer.

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Engineering Personnel Cut in Westchester County

A drastic reduction in the engineering personnel of Westchester County, N. Y., took place on May 2, when 173 persons were dismissed in a move for economy. The number of engineers employed by the park commission was reduced from 144 to 71 and 18 architects were also dropped. In the county engineer's office the staff was reduced from 120 to 44.

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Cleveland Engineers Start Back-to-Land Relief Movement

ALL unemployed engineers in Cleveland are promised early relief if the plan announced April 26 by the Cleveland Engineering Society matures. Relief is to consist in giving each unemployed engineer the opportunity of raising farm products on land in the Chagrin Valley, on the rim of the metropolitan district.

Through the joint committee on technical employment of the fourteen technical societies in Cleveland, a corporation is being formed which will administer the details of the relief plan. A 1,200-acre tract, owned by Windsor White, formerly of White Motor Co. has been put at the disposal of the committee.

There are about 4,500 engineers in the Cleveland area. Of this number some 1,400 now are unemployed. The plan to offer them agricultural relief started with George Trundle, Trundle Engineering Co., who is the chairman of the Ohio unemployment committee of American Engineering Council. He suggested to the local joint committe, after interesting Mr. White in the plan, that Cleveland engineers could, through this means, take care of their own numbers with no outside assistance. The Cleveland Engineering Society committee received the suggestion enthusiastically, with the result that plans are well under way to put the suggestion into practice.

All unemployed engineers who have registered with the society's unemployment secretary are being circularized to find out how many wish this kind of relief. It is expected that at least 300 will form the first colony. A commissary will immediately be established on the site and food and farm implements will be issued, to be paid for by scrip given each engineer. This commissary will also be charged with selling the farm produce, or bartering with merchants for clothes and household necessities. Workers on farm plots may be paid part cash and part scrip, but the greater percentage will be scrip.

Tents and cots will be given those engineers who prefer to stay on the ground. Transportation will be provided for those who now live in Cleveland and who prefer to ride to and from the farming center.

It is planned to split up the acreage into ten-acre tracts. Each man will be given one acre to work, and each ten acres will have a superintendent. Then the farm will have a superintendent. The whole corporation will be headed by a man of responsibility and business ability, who will manage the farm, commissary, etc., for the engineering society.

No donations to start the project will be solicited. Instead, $5 pledges are being asked. These pledges, when paid, will be redeemable at the commissary for farm products raised by the unemployed engineers. The corporation will allow farmer engineers to do what engineering or construction work farmers and others in the vicinity request, such as laying drainage tile, building fences and the like. The corporation will collect money for such work to bolster its finances, and pay the men doing the work in scrip.

Mr. White has donated not only the land but the services of N. H. Hill, his farm manager. Another farm syndicate has offered land and the specialized services of its farm manager, so scientific farming methods can be pursued to get the most out of the available land.

Court Permits Six Companies to Use Trucks in Tunnels

A permanent injunction restraining the State of Nevada from interfering with the use of trucks within the 56-ft. diversion tunnels at Hoover Dam was issued in favor of Six Companies, Inc., the contractor, on April 28 by three federal judges sitting en banc at Carson City. The state held that its mining laws prohibited the use of internal combustion engines underground. The court found that the size of the tunnels and the ventilation system installed eliminated all danger of carbon monoxide gas. Trucks used in the main excavation of the tunnels, now about complete, operated under the protection of temporary injunctions. Agitator trucks are now being used to convey concrete into the tunnels.

◆

Vote on $500,000 Waterworks Bonds in Louisiana Parish

A resolution authorizing a special election on May 31 in the seventh, eighth and ninth wards of Jefferson parish, Louisiana, to vote on a proposed bond issue of $500,000 for the completion of construction, improvements and maintenance of the waterworks system of the East Jefferson Waterworks District No. 1, has been adopted by the board of commissioners of the district. The bonds will run 30 years at 6 per cent. A proposed bond issue for $300,000 was defeated in the same district several months ago in a special election.

◆

New Call Made for Bids to Operate N. Y. Subway

Having received no bids for operating the new Eighth Avenue subway in New York up to April 26, the date set for opening bids on the first contract (*ENR*, March 31, 1932, p. 484), the board of transportation on April 27 issued a modified form of contract. This new form of contract is similar in most details to the original except that the operator's fee is a first lien on gross income. In the original contract the operator's fee was junior to operating and maintenance charges. If in the early days of operation the gross income was not sufficient to meet these costs the operator would have received no compensation for his efforts nor interest upon his investment of nearly $1,000,000.

◆

Optimism at Meeting of Road Builders' Association

A note of optimism prevailed at the annual meeting of the American Road Builders' Association in Washington, April 28-29. While recognizing the widespread depression conditions and the attacks that have been made on highway funds in the diversion of road money to other purposes, belief was prevalent among the directors of the association and its divisions that a concerted effort on the part of the construction industry would lead to vast improvement.

T. H. Cutler

Approval was given to the plan for a cooperative Construction Congress in January, 1933, in some city to be agreed upon by the participating organizations. It is planned to have all organizations interested in highway building meet in the same city at the same time. Each organization will have separate headquarters and hold its own meetings. One day will be devoted to a joint meeting that will attract national leaders.

A delegation of the association called on President Hoover and urged his favorable consideration of emergency highway legislation now before Congress.

Membership in the Construction League of the United States was approved.

T. H. Cutler, chief engineer, Missouri state highway commission, was installed as president. Robert B. Brooks, director of streets and sewers, St. Louis, Mo., is the new president of the city officials division, and W. O. Washington, county engineer, Cameron County, Brownsville, Tex., heads the county highway officials division.

◆

Senate Right to Recall Smith Ratification Denied

George Otis Smith lawfully holds the office of member and chairman of the Federal Power Commission, according to a unanimous decision of the U. S. supreme court handed down on May 2. The Senate challenged his right to the office because after ratifying his nomination by President Hoover it sought to have the President return the notification of the nomination in order that its action might be reconsidered.

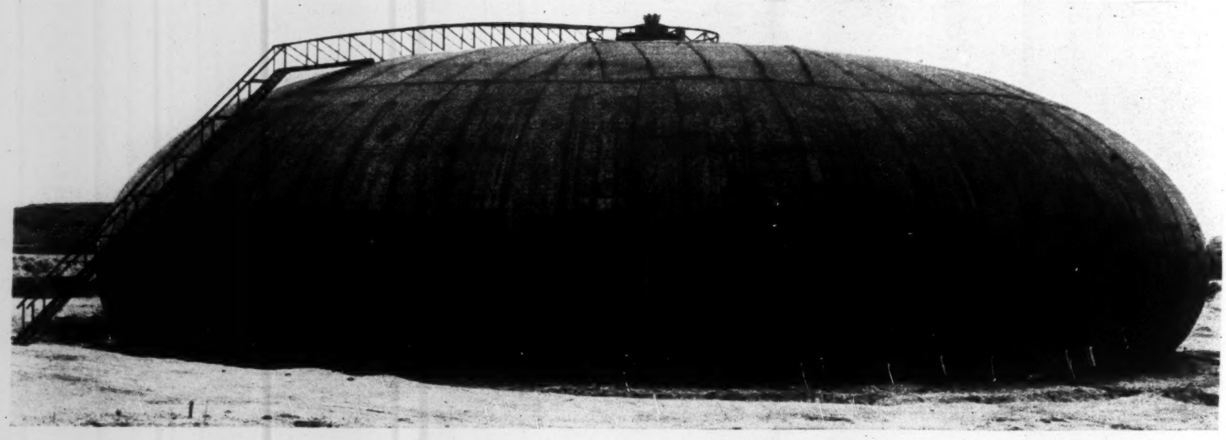
◆

Hoover Dam Notes

Practically all of the excavation for the upstream plugs in tunnel No. 2 and tunnel No. 3 at the Hoover Dam has been completed. In tunnel No. 1 about 250 ft. of work for the plug has been completed.

* * *

Excavation for the Arizona and Nevada spillways and for the Nevada intake towers was continued during the week of April 23. The adit, 130 ft. in length, to the Arizona spillway tunnel was completed and 38 ft. of pioneer tunnel was driven from the intersection where work was stopped. The remainder of the pioneer bore will be driven from the upper portal of the inclined tunnel. When operations were halted the pioneer tunnel had progressed a total length of 623 ft. from the roof of the diversion tunnel. Work was continued in the Nevada inclined spillway tunnel, enlarging it to the full size. The adit in the upstream tunnel plug in tunnel No. 2 was driven a distance of 50 ft. from its origin in the side wall of the diversion



WELDED SPHEROIDAL TANKS OF 80,000-BBL. CAPACITY

Two new welded spheroidal tanks of 80,000-bbl. capacity for the East Texas Refining Co., at Longview, Tex., are by far the largest tanks of this type. Others range from 2,500- to 20,000-bbl. capacity. The tanks, designed for 1-lb. pressure, are 136 ft. in diameter and 40½ ft. high, built of $\frac{3}{16}$-, $\frac{1}{4}$- and $\frac{5}{16}$-in. plates with welded lap joints throughout. The flat bottom rests on a graded earth base and supports interior columns which carry the roof, while truss frames reinforce the sides. This type of tank for oil and gasoline storage, whose shape for reasons of economy is that of a flexible container, such as a balloon, partly filled with liquid and set on a flat surface, was described in *ENR* of Sept. 12, 1929, p. 416. It was developed by the Chicago Bridge & Iron Works.

tunnel. In tunnel No. 2, 766 ft. of concrete has been poured; in tunnel No. 3, 500 ft. and in tunnel No. 4, 1,000 ft. Structural steel side wall forms are being erected in tunnels No. 2 and No. 3. The trash-rack foundation has been poured at the inlet portal of tunnel No. 3. The excavation of the invert section in tunnel No. 4 was stopped April 22.

* * *

More than 1,600 cu.yd. of concrete for government construction was manufactured at the mixing plant during the week. Approximately 1,000 cars of aggregates were shipped from the Arizona deposit. The drainage tunnel under the Black Canyon highway has progressed 45 ft. from the inlet portal and 22 ft. from the outlet end.

* * *

The detailed work in the tunnels during the week ended April 23 is shown by the following table:

			Progress	
Tunnel	Length	Sec.	Week	To Date
No. 1	4,300	B	520	2,001
		T	908	2,829
No. 2	3,879	B	200	2,963
		T	100	3,499
No. 33	3,560	B	190	3,060
		T	352	3,302
No. 4	4,165	B	200	3,705
		T	...	3,367
All	15,905	B	1,110	11,729
		T	1,360	12,997

B — 15-ft. bottom bench. T — trimming to full section.

◆

Contract Information Bureau Announces New Financial Plan

A new plan of financing the Bureau of Contract Information, Inc., whereby contractors who have voluntarily filed their performance records may contribute $10 yearly, is announced by the president, S. M. Williams. To date, the group of surety companies which organized the bureau about three years ago has contributed a total of $197,000 as the sole financial support of the institution.

The bureau was organized by the sureties for the purpose of collecting for their own use information concerning past performance of contractors. Soon after the organization Mr. Williams, as a trial, extended the services of the bureau to architects, engineers and public officials responsible for the award of contracts. This service soon became popular and more than 10,000 reports concerning contractors have been sent to awarding officials, the present rate being over 100 daily. Some 6,000 contractors have voluntarily filed their performance and financial records with the bureau.

The cost of dispensing information to those awarding contracts has become a financial burden on the original backers of the bureau. Rather than curtail the services to the original purpose of serving the surety companies alone, the bureau is now accepting annual contributions of $10 from contractors, but only from those who have voluntarily filed their reports, on the ground that responsible contractors receive the most benefit from the services now rendered. If the response is sufficiently great the activities of the bureau will be carried on as at present. All funds received from contractors will be used only to defray the cost of supplying information to those responsible for the award of contracts. The surety companies will continue to finance the collection of information and the cost of services they require.

Offices of the Bureau of Contract Information have recently been moved to 729 Fifteenth St., N. W., Washington, D. C.

◆

School for Public Officials

A week of intensive study and training for men in every branch of governmental activity is offered in the fifth annual Short Course in Public Administration to be held June 13 to 17 by the school of citizenship and public administration of the University of Southern California at Los Angeles. Last year engineers formed the largest group, being particularly interested in the water supply, sanitary engineering and municipal engineering sections. Courses in these subjects, as well as others, will be offered this year.

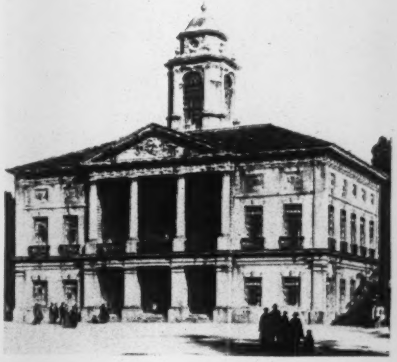
◆

Replica of Federal Hall Built in Bryant Park, New York

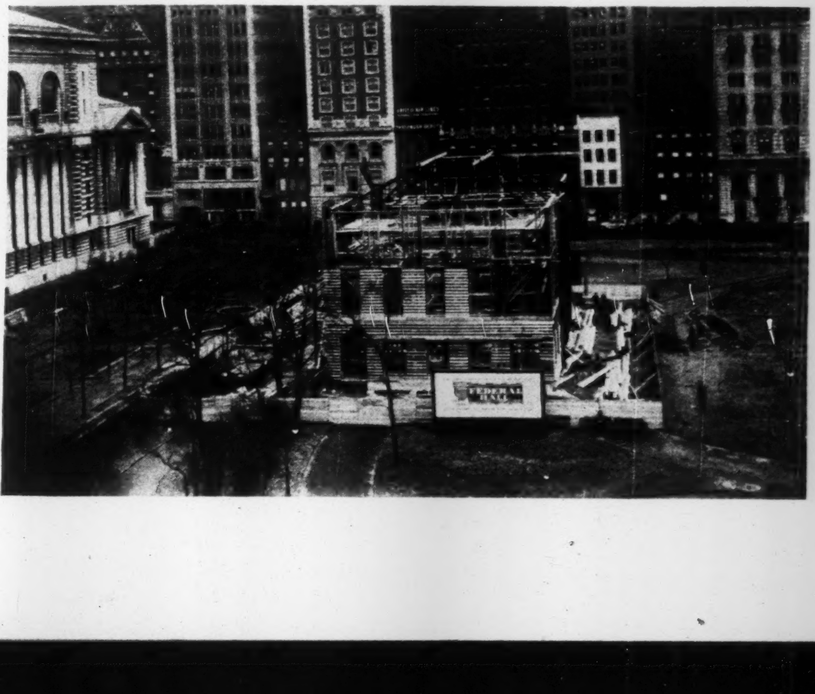
On April 30 in New York City the activities of George Washington on the day he took the oath of office as the first President of the United States were reenacted as part of the bicentennial celebration of his birth. The oath was administered in a replica of Federal Hall built by the home construction division of Sears, Roebuck & Co. in Bryant Park west of the Public Library. The building and the surrounding grounds were made as nearly like the original layout as the data available from old prints and drawings permitted.

Although the bearing walls of original Federal Hall were of stone, the short time allowed for construction of the replica made faithful reproduction of this portion of the building out of the question. As an alternative, timber covered with heavy gypsum board plastered was utilized. Unusually long length timbers of Pacific Coast fir, carried in stock at the Sears, Roebuck plant in New Jersey, were used for the principal members. The exterior dimensions of the building are 59x95 ft. at the first floor level. Timber columns required to carry the 60-ft. roof trusses were found to be too large for architectural requirements, and steel columns and trusses were used at these points. With this exception all framing is timber. Corner posts are 12x12-in. timbers 48 ft. long. Sidewall studs are 2x12- and 3-12-in. rough fir, doubled at all jambs. The lower section of the studding is 36 ft. long, extending to the auditorium ceiling. The upper sections continue for 12 ft. to the eaves, having a 4-ft. lap splice. Tops of the studs are plated and ribboned with 2x12 planks. The roof consists of a platform section supporting the cupola carried on stringers framed over the top chords of the transverse trusses. The stringers extend to meet the end hips, which are laminated trusses in which the upper fourth of the corner posts form a portion of the top chord. Double rafters are placed at all jamb studs and are kneebraced with two 2x10-in. planks. This type of roof bracing was adopted to insure maximum rigidity against wind. A roof finish of composition shingles was utilized. To support the artificial "stone" exterior 1x6-in. on the studding. Plaster casts were used for cornices and like details.

Architect's sketch of Federal Hall, New York.



Replica of Federal Hall utilizes timber construction with the exception of long-span roof trusses and proscenium arch, which are steel. The building is faced inside and out with gypsum board.



Low Costs Mean More Paved Roads in Indiana

The Indiana highway commission will be able to build nearly 100 miles more of paved roads this year than was planned originally as a result of heavy reductions in construction costs, it is announced by Ralph Simpson, assistant director of the commission. Mr. Simpson says the commission originally had planned to build about 500 miles of hard surfaced roads this year. He added that when the May 17 letting is completed 525 miles will be under contract and this total can be increased later to about 600 miles. Engineers' estimates for work this year was based on last year's costs, and the bids offered thus far have been from 25 to 35 per cent under the estimates. More bids per project have been received this year than in any year since the commission has been organized.

◆

Rivers and Harbors Congress Called in Special Session

A special session of the National Rivers and Harbors Congress has been called by Congressman Frank R. Reid, of Illinois, president of the Congress, to convene in Chicago on June 13 and 14, just prior to the Republican and Democratic national conventions.

The purpose of the meeting, according to the president's call sent to the members and to the governors of all states, mayors of municipalities and officials of civic organizations, is to formulate plans to resist organized efforts which threaten seriously to impair or perhaps cause the abandonment of the entire national system of waterways; to prepare resolutions, and to provide for the appointment of committees to present them before the resolutions committees of the Republican and Democratic national conventions.

◆

New Reading R.R. President Began as Rodman

Charles H. Ewing, who began his career with the Pennsylvania & Reading R.R. as a rodman, has been elected president of the railroad to succeed the late Agnew T. Dice. Mr. Ewing, who studied civil engineering under a private tutor, was rodman, assistant engineer and supervisor of the P.&R. from 1883 to 1892, division engineer and chief engineer of the Central New England Railway from 1892 to 1902, and division engineer and engineer, maintenance-of-way of the P.&R. from 1902 to 1910. He has been vice-president of the railroad since 1920.

◆

Los Angeles County Adopts Five-Day Work Week

A five-day work week for 11,000 employees in the governmental work of Los Angeles County, Calif., was ordered April 27 by the board of supervisors, to become effective July 1 next, the beginning of the fiscal year. The new work week basis means a one-half day pay cut. The five-day week for county employees, along with reductions in department personnel, elimination of pay while on sick leave, and vacation relief, is expected to result in a saving of at least $3,000,000 in the salary budget, which for the present fiscal year was $19,397,362.

The supervisors discussed, but did not act upon, salary reductions in addition to the half-day pay cut, particularly for department heads receiving $8,000 a year or more.

◆

Reduction in San Francisco of Building Wage Scale

The San Francisco Builders Exchange has announced a 20 per cent reduction in the wage scale for all building trades in that city, effective April 18 for the remainder of 1932. The wage scale in effect before this reduction was established by the impartial wage board, appointed by the Industrial Association of the East Bay and San Francisco to establish a wage scale for 1932. The Builders Exchange does not have official jurisdiction over the wages set by the impartial wage board, but several of the trades have already agreed to accept the proposed cut.

A 20 per cent reduction in wages for all members of the various building trades in the East Bay district was voted by Alameda County Chapter, Associated General Contractors of America, as an indorsement of action taken by the San Francisco Builders Exchange.

◆

State Division of Engineering Established in Ohio

In order to coordinate the work of engineers attached to several state departments and to reduce the number of such engineers from eleven to nine, a state division of engineering has been set up for Ohio, according to an announcement by T. S. Brindle, state director of public works. Three engineers in the department of public works, two in the department of public welfare and three in the state department of agriculture, together with one of three in the department of finance now assigned to problems in reducing costs of mechanical operations, will compose the new division.

◆

Louisiana Highway Creditors Receive Cash and Scrip

The Louisiana highway commission on April 25 delivered its issue of $15,000,000 of highway bonds to the Pyramid Securities Co., receiving a certified check for $15,083,334, representing par and accrued interest on the bonds from March 15. The commission immediately issued a check to the Hibernia Bank & Trust Co. as trustee in full payment of the warrants or scrip deposited with the trustee by the warrant holders for redemption under the plan proposed by Senator Long whereby the warrant holders received 80 per cent cash on the face value of their warrants and the remaining 20 per cent in participating certificates.

As the result of this transaction, the highway commission has discharged virtually all its present indebtedness and will now immediately undertake to devise plans for the completion of the present construction program.

The banks holding the bonds cannot sell any of them at less than par without authorization before Jan. 1, 1933. After that date the loan obligations incurred against them can be liquidated in the open market.

◆

Work Resumed on Denver's Eleven-Mile Dam

Blasting and rock-crushing operations at Eleven-Mile Dam in South Platte Canyon, a Denver water department project, were resumed on April 15. Sixty men are engaged on the work, which is preliminary to construction of spillways and pouring concrete. C. C. Schrepferman, manager of the municipal water department, expects that the dam and reservoir will be completed this summer or fall.

Another crew of 60 men, under direction of Mr. Schrepferman, has resumed work lining the Moffat water tunnel, designed to bring water from Colorado's western slope.

◆

Brief News

Highway Contracts totaling about $2,000,000, covering paving of 83 miles of road, construction of 11 miles of graded road and construction of 24 bridges in various parts of the state, have been let by the Georgia state highway commission.

Headquarters of the Northeastern Forest Experiment Station will be transferred from Amherst, Mass., to New Haven, Conn., about June 1, the secretary of agriculture announces. The station will occupy office and laboratory space in a building owned by Yale University.

Natural Gas will be served to San Diego, Calif., about Sept. 1, according to an announcement by President William F. Raber, of the San Diego Consolidated Gas & Electric Co. Construction of 95 miles of 12¾-in. transmission main from Long Beach will be required.

Receivers have been appointed for the toll bridge over the Mississippi River at Cairo, Ill., operated by the Cairo Bridge & Terminal Co. The bridge was constructed last year at a cost of $3,100,000. The financial statement lists liabilities of $2,600,000.

Erection of a Storage Dam at Upper Kananaskis Lake will be started this summer by the Calgary Power Co., of Calgary, Alberta. The company has already completed a construction road to the site. The new dam will give an additional storage for power purposes of 50,000 acre-ft. of water and will cost about $100,000.

A Six Weeks' Course on the principles and practical application of geophysical methods, from July 11 to Aug. 20, will be offered by the Colorado School of Mines at Golden, Colo. The course will consist of lectures, laboratory work and field work under the direction of Prof. Carl A. Heiland, head of the department of geophysics.

Salt River Valley Reservoirs Hold Record Storage

Reservoir storage behind the dams of the Salt River Valley Water Users' Association, Phoenix, Ariz., has exceeded past records and on April 11 totaled 1,367,000 acre-ft., compared with a storage of 425,000 acre-ft. in the reservoirs a year ago at the same time. Although no rain has fallen for several weeks, the storage continues to increase from the melting snows on the watershed, which have been unusually heavy this season. The storage by reservoirs is as follows:

Reservoirs	Storage April 11, Acre-Ft.	Storage Capacity, Acre-Ft.
Roosevelt	1,020,000	1,637,000
Horse Mesa	240,000	245,000
Mormon Flat	50,000	63,000
Stewart Mt.	62,000	70,000
Total	1,372,000	2,015,000

This figure corresponds to the previous record established Feb. 17, 1920, when the reservoir storage totaled 1,367,000 acre-ft. According to C. C. Cragin, general manager and chief engineer, the volume of storage available this year will result in decreased assessments to the farmers on the project because of the resulting increase in hydro-electric power sales from the association's power plants on Salt River and because it will be unnecessary to pump water for irrigation use. Practically the only pumping required will be for drainage purposes. Last year more than $543,000 of power was used for irrigation pumping.

The coming year's budget, already fixed, makes the assessments against the farmers only $1.50 per acre.

◆

$1,000,000 Unemployment Bonds Proposed in Portland, Ore.

Legal approval of issuing and redemption provisions for an issue of $1,000,000 of general obligation bonds of the city of Portland, Ore., for emergency relief has paved the way for putting the issue of these bonds to a vote of the people at the primary election on May 20. The proceeds of the issue, if voted, are to be used to provide employment on useful city work to unemployed residents of the city, continuing the relief afforded by a similar issue voted a year ago, the proceeds of which have been practically exhausted.

Unusual provisions of this issue are that the bonds may be issued in denominations as small as $100 and may be sold over the counter at par.

◆

State Health Board Fosters Voluntary River Cleansing Body

For the purpose of improving the upper reaches of the Potomac River above Cumberland, Md., there was formed in 1929 the Upper Potomac River Board, a voluntary organization suggested by the Maryland state board of health and including four major manufacturing companies and the city of Cumberland. Heavy pollution of the stream by mine wastes as well as by wastes from the industries presents a serious problem, particularly at low stages, when the water must be re-used several times. The new board has financed a program involving uniform analyses each week at seven points and the U. S. Geological Survey has established gaging stations in conjunction with the companies. A five-year program has been agreed upon, at the end of which time it is hoped the state will continue the program.

Hundreds of thousands of dollars have been spent by the companies and the analyses show much improvement in the 2½-year period since the river has been under close observation. Because of mine waste and sanitary sewage from many sizable towns, the river, even with complete elimination of all industrial waste, would hardly support fish much farther upstream than at present. This conclusion, with a suggestion that a more uniform flow in the river be provided by a series of dams, is contained in the lately issued first report of the Upper Potomac River Board, for whose existence Abel Wolman, chief engineer, Maryland state board of health, is largely responsible.

◆

Private Toll Bridge Betweeen Minnesota and Ontario

Under recent authorization by Congress the Lake of the Woods International Bridge Co. has awarded a contract to W. W. O'Connor, of St. Paul, for the construction of a toll bridge between Beaudette, Minn., and Rainy River, Ont. The bridge is a private project for which the capital is almost entirely subscribed. The work will be carried on during the next few months to insure the opening of the bridge in time for the tourist season. The structure will be 1,250 ft. long, of concrete and steel, and will cost $350,000.

Kentucky to Build Highways by Force Account

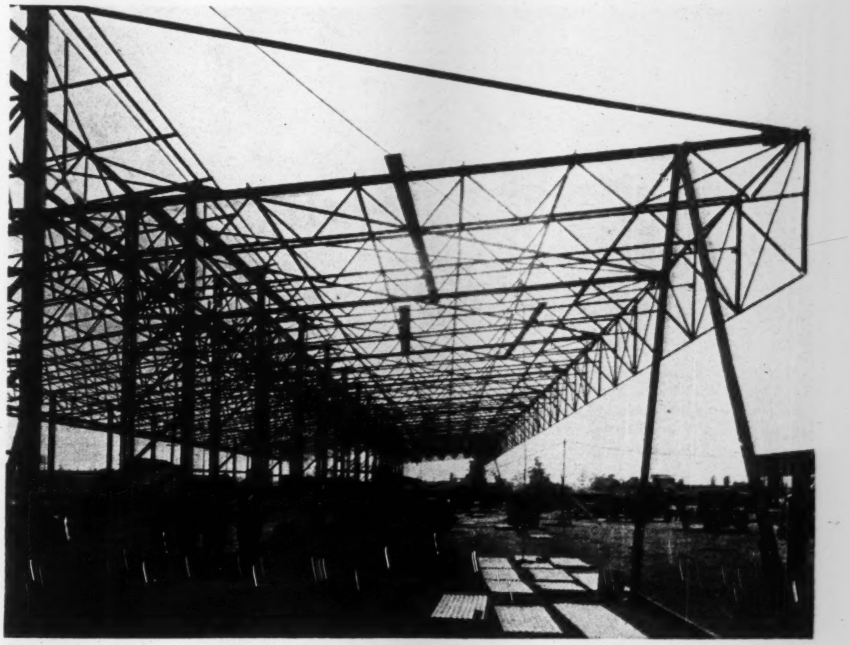
Ben Johnson, chairman of the Kentucky state highway commission, announced on April 26 that the department is contemplating building considerable mileage this year with its own force account instead of letting contracts. Mr. Johnson holds that the state will profit through lower prices if contractors are compelled to meet competition of the state force account. He also stated that the state engineers would be held accountable for seeing that the work is done on the basis of their estimates.

A maintenance budget of $4,582,000 has been adopted by the highway department for 1932.

◆

Vertical-Fiber Lug Brick Added to Standards

A sharp increase in the production of vertical-fiber lug brick to 28.6 per cent of the total in 1931 has been recognized by placing it among the adopted standards of the permanent committee on simplification of variety and standards for vitrified paving brick of the department of commerce. Acting at its meeting in Washington, D. C., April 14, the committee substituted the 3½x4x8½-in. vertical-fiber lug brick as one of its six standard varieties and sizes in place of the 3½x4x8½-in. vertical-fiber lugless brick which in the last three years has constituted less than 3 per cent of the total production. The rapid increase in the use of the new standard is the result of improvements in lug design and manufacturing processes which make mass production possible.



WELDED CANTILEVER ROOF OF LONG SPAN

In a new 100-ton all-welded building in Los Angeles, an outstanding feature is a 30-ft. overhang for sheltering trucks at a loading platform. The over-all dimensions of the building, erected by the Soule Steel Co. for the Pacific Freight Line, are 290x80 ft. According to the General Electric Co., a crew of ten men erected the building in 21 days.

Personal Notes

A. R. Garnock has been appointed city engineer for the city of Eau Claire, Wis., to succeed Carl F. Meyer, who has gone into private practice.

Joseph Sullivan, a contractor, has been appointed building commissioner for University City, Mo., succeeding Arthur H. Kuhlmann, resigned.

George P. Trax has become associated with the Kay Engineering Co., Inc., consulting engineers, New York City, as chief engineer.

Sherwood A. Cheney, colonel, Corps of Engineers, who has been district engineer of the Boston, Mass., district, has been relieved of duty there and ordered to report to Fort Logan, Colo.

Robert I. Randolph, of the Randolph-Perkins Co., consulting engineers, Chicago, has been appointed director of operations of the Chicago World's Fair, 1933.

A. E. Hess, city chemist in charge of the sewage-treatment and water-purification plants in Alliance, Ohio, since 1918, has resigned to accept the post of sanitary engineer at the sewage plant of Canton, Ohio, succeeding C. C. Hommon.

George B. Hegardt, for the past eight years manager and chief engineer of the port of Oakland, Calif., has resigned, but will be retained in an advisory capacity. He will be succeeded by his assistant, Arthur H. Abel, as acting port manager and chief engineer of the harbor.

Harvey Slocum, general superintendent in charge of construction of the Madden Dam in the Canal Zone, has resigned and his place has been filled temporarily by Paul Graef, vice-president of the Callahan Construction Co., one of the contracting firms building the dam. This is Mr. Slocum's second resignation, the first, several months ago, having been withdrawn.

Arthur W. Cory, formerly resident engineer of the Los Angeles, Calif., County Sanitation District No. 5, has been appointed city engineer of Inglewood, Calif., to succeed Willis S. Peffer, who died on April 22. As Inglewood city engineer, Mr. Cory returns to a position he left in 1926 to become resident engineer for the sanitation district. He first was appointed city engineer in 1915 and now is assistant street superintendent.

Max C. Tyler, lieutenant colonel, Corps of Engineers, who has been assistant to the division engineer, Gulf of Mexico Division, has been named district engineer, First New Orleans district. His new duties include all river work on the Mississippi River except flood-control work, and river and harbor work on other streams and inland waterways in the New Orleans region.

R. R. Ellis, engineer for the Frederick Snare Corp., left New York April 22 for Cartagena, Colombia, to be engineer in charge of a large harbor and port development there, the work including the construction of 1,065,000 ft. of reinforced-concrete wharf and warehouse and 2,000,000 cu.yd. of dredging in the harbor and an existing canal that connects with the Magdalena River. The work aggregates about $2,500,000, financed jointly by the national government, the Andean National Corp., a subsidiary of the Standard Oil Company of New Jersey, and the contractor. Mr. Ellis, who has previously been on South American work for the Frederick Snare Corp., has been spending the past year on some of the company's domestic jobs. The contract time for the Cartagena work is 27 months. William Coleman, recently on work for the company in Lima, will be superintendent of the Cartagena job.

P. J. Freeman, for many years chief engineer of test and specifications of Allegheny County, Pa., has joined the staff of the Pittsburg Testing Laboratory as consulting engineer. Mr. Freeman will specialize in problems relating to municipal construction, roads and pavements, technological control of concrete production and placement and special investigations.

Vincent G. Lamb, who has been assistant city engineer of Watervliet, N. Y., for the past nine years, has been appointed city engineer by the city council.

Ralph M. Bryant, assistant engineer, western division, Southern Pacific Co., San Francisco, has been appointed city manager of Alameda, Calif., effective May 1. Mr. Bryant started with the Southern Pacific as assistant engineer on the Portland division in 1912. He was assistant city engineer of San Francisco, working on the reconstruction of the water and sewer, for two years following the 1906 earthquake and fire. Mr. Bryant succeeds Neil B. Pierson, who has been city manager of Alameda for the past year.

SOCIETY CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 20-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Yellowstone National Park, July 6-9.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 40th annual meeting, Oregon State College, Corvallis, June 29-July 1.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS will hold its semi-annual meeting June 27-29 in Milwaukee, Wis. Technical sessions will be held on each of the three days and an unusually attractive social program has been provided.

INDUSTRIAL ACCIDENT PREVENTION ASSOCIATION held its annual convention in Toronto April 21-22, attended by about 1,000 delegates representing 900 plants in Ontario. Papers were read on methods of preventing accidents and urging cooperation among manufacturers in safety campaigns. Officers were elected as follows: president, C. G. Cockshutt, Brantford; vice-president, P. J. Wood, Ottawa, and O. H. Shenstone, Toronto; treasurer, W. S. Campbell, Toronto; general manager, R. B. Morley.

NEW ENGLAND WATER WORKS ASSOCIATION will hold its spring meeting in Nashua, N. H., on May 11. The annual convention of the association will be held in Springfield, Mass., Sept. 27-30.

SMOKE PREVENTION ASSOCIATION will hold its 26th annual convention in Toronto, Canada, June 7-10. Frank A. Chambers, City Hall Square Building, Chicago, is secretary.

WATERTOWN DIVISION, New York State Highway Engineers Association, at its annual meeting on April 26 reelected J. P. Lynch president and Thomas Howard secretary. E. S. Booth was elected vice-president.

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Obituary

Robert S. Sumner, civil and hydraulic engineer, of Denver, Colo., and former general manager of the Denver Water Co. and chief engineer for the Denver water board, died suddenly April 23 while on a visit to Albuquerque, N. M. Mr. Sumner was 56 years of age.

John A. Miller, architect, of Birmingham, Ala., died on April 19 following an illness of several months. Mr. Miller, who was 69 years old, practiced his profession for some time in Philadelphia and New York and went to Birmingham in 1900, where he formed the firm of Miller & Martin, which designed and supervised the construction of some of the largest structures in Birmingham and other sections of the South.

Charles C. Small, deputy state highway engineer of Arizona, died in Phoenix, Ariz., on April 5. Mr. Small was born in North Truro, Mass., in 1874, and began his engineering career in 1890 as a rodman on the New York, New Haven & Hartford R.R. Later he was engaged on various railroads, including the Atchison, Topeka & Santa Fe, the Southern Pacific and the El Paso & Southwestern (now part of the Southern Pacific), as well as the Mexican Central, the Chihuahua & Pacific and the Parral & Durango, of Mexico, and the Bolivia State Railway. He was appointed deputy state highway engineer of Arizona in 1928. Mr. Small was a member of the American Society of Civil Engineers.

Charles Sinclair Hobbs died at his home in Las Cruces, N. M., on April 2 after a week's illness of pneumonia. Mr. Hobbs, who was born in 1866, had been in active civil engineering practice since 1888. He engaged in much railroad location and construction work in the West and Southwest and also was connected with the design and construction of several municipal water-supply systems in the Northwestern states. For twenty years prior to 1929 he was engaged in private engineering practice in Brownsville, Tex. In 1929 he went to Las Cruces, where he had since been in consulting practice with his son-in-law, H. B. Elmendorf.

Allan Vinal Garratt, consulting engineer in hydro-electric work, died on April 30 at his home in Holliston, Mass., at the age of 69. Mr. Garratt was the first secretary of the National Electric Light Association and was chairman of the first committee to draw up an electrical safety code and of the first committee on wire gage standards.

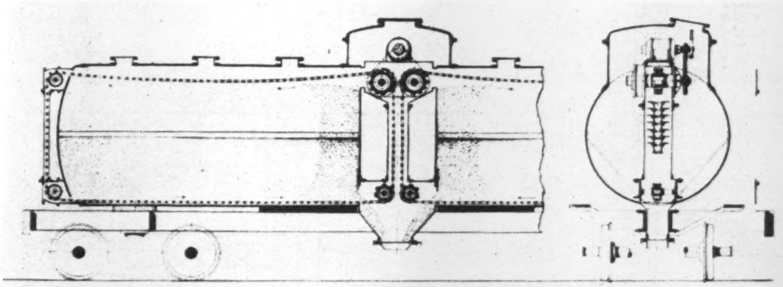
George McClellan Taylor of Red Bank, N. J., died on May 1 at the age of 77. Mr. Taylor was field engineer in charge of building the Harlem ship canal in New York City and was the civil engineer in charge of the enlargement of Governors Island from 1901 to 1911. He also served many years in the New Jersey highway department.

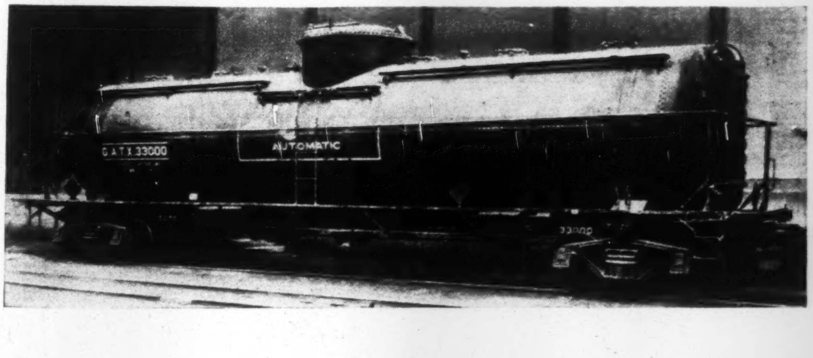
Construction Equipment and Materials

Self-Unloading Tank Car for Bulk Materials

The General American Tank Car Corp., in conjunction with the Link-Belt Co., has developed a self-unloading tank car for the transportation of dry commodities in bulk. This car has been designated as the "Dry-Flo." It is designed for transporting such ladings as cement, dolomite, pebble lime, hydrated lime and soda ash as well as many other materials. The car, with a tank capacity of 1,600 cu.ft., is divided into three compartments, one at the center housing the unloading machinery and the two others for carrying the materials. The car is loaded through six 16-in. openings in the top and is unloaded through a single opening in the bottom at the center, the unloading being done in connection with a screw or other type of conveyor placed on top of the rails under the car. The unloading mechanism consists of two power-driven drag chain conveyors, one in each compartment, which are pulled along the tank bottom toward the center outlet by means of sprockets located in the center compartment. The empty conveyors travel up the center compartment along the top of the car and down the end of the car outside of the compartment. The conveyors are driven by a motor located in the dome, or by external power applied to a shaft provided for that purpose. Provision is made for throwing out power on one end of the car, and also for starting one end at a time. With the average discharge rate of 400 cu.ft. per hour using one chain, or 800 cu.ft. per hour using both chains, the car can be unloaded in about two hours, the exact length of time depending upon the character of the commodity. The discharge is arranged to empty the car completely. Experience has shown that no bulk material, not even cement, arches or packs sufficiently solid to prevent unloading.

Dry-Flo tank car for transportation of bulk commodities. Unloading is done by drag chain conveyors.





Business Notes

Servicised Products Corp., Chicago, announces the appointment of H. M. Orschel as field sales manager.

Northern Engineering Works, 210 Chene St., Detroit, has developed a welding division experienced and equipped to design and produce a wide variety of welded steel products for commercial use, including steel frames, bases, gear housings, casings and other fabricated structures.

Link-Belt Co., Chicago, announces the election of George P. Torrence as president of the company. He was formerly vice-president in charge of the company's Indianapolis operations.

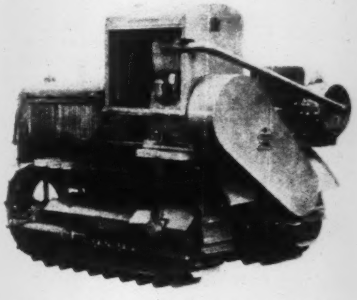
Tractor Equipment Co., Cleveland, Ohio, has been organized to manufacture a varied line of earth-moving equipment including wheel scrapers, roll-over scrapers, crawler wagons and bulldozers. T. H. Taylor is general sales manager and G. E. Armington is chief engineer. The sale of the equipment will be handled mainly through distributors of the Cleveland Tractor Co.

Goodman Manufacturing Co., Chicago, has acquired the business of the Mancha Storage Locomotive Co., of St. Louis. Although the business will eventually be moved to Chicago, it will be operated independently as a separate company under the name of the Mancha Storage Battery Locomotive Co. The present active Mancha management will continue in charge.

F. H. Niles, president of the Wickes Machinery Co., is continuing the business recently discontinued by that company as manufacturers' agent and dealer in power and contractors' machinery. Offices have been established at 880 Bergen Ave., Jersey City, N. J.

Air Compressors Mounted on Standard Tractors

Schramm, Inc., West Chester, Pa., is announcing its regular line of air compressors mounted on the frame of any standard-make tractor and driven from the power take-off by the latest type "V" belt pulley. These compressors are furnished in three sizes, 72-, 120- and 180-cu.ft. displacements, and are mounted alongside the driver's seat on a separate sliding frame which can be removed with little effort. The compressor is protected from weather by a steel housing equipped with removable sliding doors that may be padlocked. Belts and pulleys are likewise protected by a complete inclosure. The compressor mounting does not alter or affect pulling or towing features of the tractor drawbar.



Schramm tractor-mounted compressor.

New Publications

Industrial Windows—Mesker industrial windows and Mesker wrought-iron sash are covered in two new catalogs issued by the Mesker Bros. Iron Co., 424 South Seventh St., St. Louis, Mo. Mesker has also issued an addendum to its general catalog covering insect screens, architectural projected windows, basement windows and industrial doors.

Dragline Bucket—The Williams "Double-Arch" dragline bucket is described in a new bulletin issued by the Wellman Engineering Co., Cleveland, Ohio.

Standard Steel Buildings—A well-illustrated 48-p. booklet published by International-Stacey Corp., Columbus, Ohio, covers an entire line of standard steel buildings for all industrial purposes.

Aluminum and Its Alloys—The Aluminum Company of America, Pittsburgh, Pa., has published a 54-p. booklet entitled "Alcoa Aluminum and Its Alloys." Applications and uses of the various types of aluminum alloys are described in full. An appendix carrying tables giving the chemical composition and typical mechanical properties and characteristics of the various alloys is included.

Water-Filtration Equipment—The principles of filtration, the pretreatment of different classes of water, the various types of chemical feeds, vertical and horizontal pressure filters, concrete and wood gravity filters, and activated carbon filters are described in a 28-p. illustrated bulletin entitled "Water Filters and Filtration Equipment," published by the Permutit Co., 440 Fourth Ave., New York City.

Water and Sewage Clarifiers—Hardinge clarifiers for sewage treatment, water purification and industrial waste treatment are described in bulletin No. 38 issued by the Hardinge Co., Inc., York, Pa. Many types of clarifiers to meet every requirement are described.

Hydraulic Valves — Baldwin-Southwark Corp., Philadelphia, Pa., has issued a bulletin describing a new line of valves especially designed for the field of waterworks and hydro-electric power generation. The valves were designed for handling water at high velocities through long pipe lines and to eliminate dangerous pressure surges and water hammer conditions.

Business Side of Construction

Four Months' Construction Shows 64 Per Cent Drop

April contracts averaged 24 millions per week, compared with 21 millions for the four months. This compares with an average of 63 millions for April, 1931, and 59 millions for the four months of that year. The year's drop is 64 per cent from 1931.

One year ago engineering construction contracts were being let at the rate of 54 millions per week, which compared quite favorably with the rate during the first four months of 1930. The long severe drop in volume did not begin until May, 1931.

Comparison of this year's low volume with last year's comparatively large volume is therefore not particularly helpful. Furthermore, the drop of 64 per cent thus shown is revised to 55 per cent when compensation is made for present low costs of construction.

Residential building volume has been remarkably uniform, in millions as follows: January, 28; February, 24; March, 33; April, 28. The narrow range suggests that the minimum for this class may have been reached.

New capital issued in the four months totals 524 millions, which though only 49 per cent of last year's productive bonds and stocks represents 62 per cent of last year's structure volume.

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Materials Notes

Heavy decreases in construction volume have of course been reflected in the materials markets. Freight-car requirements foreshadowed for the second quarter anticipate the following reductions from year-ago loadings: sand, gravel and stone, 21.6 per cent; lumber, 19.8; clay products, 18.9; cement, 16.7; iron and steel, 14.7; lime and plaster, 12.2; prepared roofing, 7.4; explosives, 4.7 per cent. Small demand has naturally resulted in sluggish price quotations. Prices are at least 13 per cent below year-ago levels, and 24 per cent below those of two years ago.

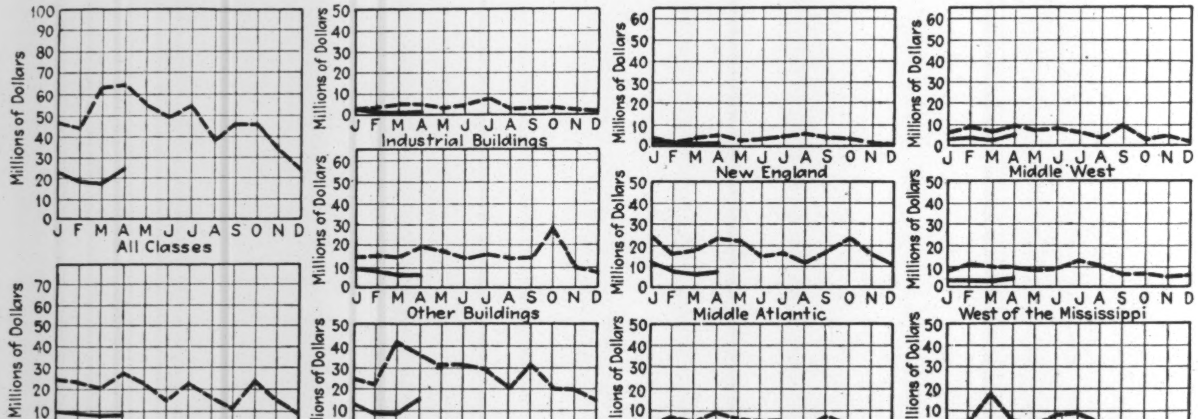
Structural Steel—The formal quotation for structural shapes has been $1.60 since April 1. Before that date the price was $1.50, and this is the price quoted now by *Engineering News-Record* in the price pages which follow. Foreign steel is being sold at New York dock for as low as $1.10 duty paid; but the material is chiefly light angles and bars and not the wide-flanged shapes which comprise probably three-quarters of the structurals used in buildings. The weekly rate of order placing for fabricated shapes is only 14,000 tons, compared with 41,000 in April, 1931, but it is 5,000 tons heavier than the March rate.

Five open-hearth furnaces opened on April 17 in the Birmingham district to fill railway maintenance requirements. Freight rate on mixed-lot shipments of iron or steel pipe from the Gulf region to the Southwest has been advanced 2.5c. per 100 lb., to 88.5c., by order of the Interstate Commerce Commission. Mixed-carlot shipments containing pipe bore a rate of 86c. per 100 lb., while shipments consisting entirely of pipe cost 88.5c. A practice

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN APRIL, 1932

Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States			Canada April, 1932
							April, 1932	Four Months		
								1932	1931	
Waterworks	$140	$1,005	$35	$210	$388	$49	$1,827	$6,339	$21,302	$235
Sewers	163	322	40	191	1,260	210	2,186	9,226	27[illegible]49	316
Bridges, public	198	1,549	108	1,318	758	302	4,233	13,996	33,573	50
Excavations	24	9	15	132	15	16	211	1,392	6,941	75
Streets and roads	1,332	2,839	2,685	6,205	9,560	5,416	28,037	65,964	211,313	599
Federal government	672	4,583	1,759	3,299	541	309	11,163	48,899	117,761	......
Unclassified, public	204	2,085	451	217	218	6,383	9,558	19,644	40,228	41
Buildings, public	1,843	1,106	253	2,551	778	361	6,892	35,984	87,105	1,060
Total public	4,576	13,498	5,346	14,123	13,518	13,046	64,107	201,444	545,372	2,376
Buildings, industrial	1,069	2,250	1,185	625	386	1,230	6,745	31,247	67,785	801
Buildings, commercial	1,230	6,540	335	3,225	1,350	732	13,412	86,808	218,320	......
Bridges, private	....	....	....	....	350	....	350	1,240	305	......
Unclassified, private	787	4,208	727	300	1,494	3,475	10,991	28,500	148,206	55
Total private	3,086	12,998	2,247	4,150	3,580	5,437	31,498	147,795	434,616	856
April, 1932, 4 weeks	**7,662**	**26,496**	**7,593**	**18,273**	**17,098**	**18,483**	**95,605**	....	....	**3,232**
March, 1932, 5 weeks	7,859	30,215	4,490	12,307	18,176	13,072	86,119	....	....	4,530
April, 1931, 5 weeks	28,290	117,867	42,870	50,898	47,710	29,270	316,905	....	....	12,640
Four months, 1932	27.677	127.824	21 145	59,049	60,197	53,347	....	349,239	....	......
Four months, 1931	63.839	368,464	101·874	150,198	158,270	137,343	....	....	979,988	46,109



Value of contracts awarded—Weekly averages.

developed of including a 100-lb. keg of nails in the pipe cargo.

Lumber—Demand is small, with many mills shut down, and stocks 21 per cent lighter than a year ago but totaling 3,587,000,000 ft. Shipments are 34½ per cent below those of the first fifteen weeks of 1931. Fir prices have dropped to the 1910 level of $10 to $11 at mill. Price to contractor in New York is $26.50 delivered. Comparable price for longleaf pine timbers is $43.

Cement — Manufacturers report volume half that of a year ago, checking almost exactly with the drop in structure volume; but they profess to see prospects of greater activity. The post office program has furnished a steady customer this year. One of the largest orders in immediate view is the 350,000 bbl. for locks in the Ohio River at Midland, Pa. There have been no changes in mill prices.

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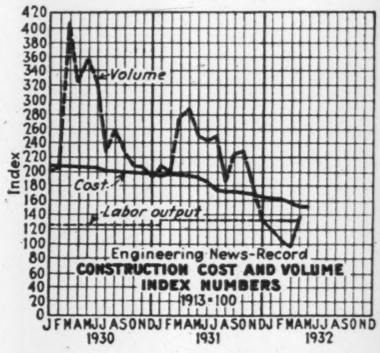
Construction Cost and Volume Index Numbers

The May Cost Index (152.78) is 0.2 per cent under that for April and is 19.5 per cent below that for May, 1931. It is the lowest since December, 1916, at which time the Index touched 149.41. The April Volume Index (135) is 39.1 per cent greater than that for March and is 53.2 per cent smaller than that for the month of April, 1931.



E.N.-R. Cost		E.N.-R. Volume	
May, 1932	**152.78**	**April, 1932**	**135**
April, 1932	153.12	March, 1932	97
May, 1931	189.33	April, 1931	289
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.85	1930 (Average)	260
1913 average	100.00		
1931		1931	
January	194.48	January	208
February	196.61	February	198
March	194.51	March	278
April	191.63	April	289
May	189.33	May	251
June	187.23	June	243
July	174.37	July	248
August	171.38	August	187
September	171.40	September	225
October	169.78	October	229
November	169.28	November	180
December	166.23	December	133
1932		1932	
January	162.48	January	121
February	161.82	February	105
March	157.24	March	97
April	153.12	April	135
May	152.78		

Scale Cuts Continue

Wage scales continue to be revised downward, usually with the consent of the unions. Occasionally, as at New York, the contractors have merely posted a list of wage rates which they profess to be willing to pay. Scale reductions of the last month are given below:

Boston—Plumbers, 15c. per hour, to $1. Rates on domestic work down 35c., to $1.40.

New York—25 to 30 per cent for all trades, totaling 115,000 union mechanics. The 30,000 who were employed have been called on strike in protest of a special agreement made with the elevator constructors.

Newark—Masons' laborers, $2.40 per day, to $7.60.

Elizabeth, N. J.—Painters, $2, to $10.

Philadelphia—16⅔ per cent.

Pittsburgh—Sheet metal, $2, to $10.50, stonecutters, $3, to $10; tile setters, $2.30, to $10.20. Eight public projects to start soon will employ 1,350 men.

Memphis—Painters, $2, to $6.

Alton, Ill.—$2 per day cut for bricklayers (to $12), plumbers and steamfitters ($10), carpenters, painters, electrical, sheet metal plasterers' laborers ($8); $1.48 for bricklayers' laborers ($7.72); and $0.80 for steamfitters' helpers ($5.60); $0.60 for building laborers (to $5.40).

Belleville, Ill.—Bricklayers, 25c., to $1.50.

Galesburg, Ill.—Painters, 50c. per hour, to 75c.

Peoria, Ill.—Bricklayers, 25c., to $1.25.

St. Louis—4 to 17 per cent for all trades exclusive of plumbers and steamfitters (on strike), and plasterers (negotiating).

San Francisco—20 per cent for carpenters and plasterers.

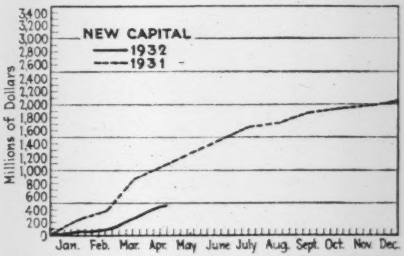
Wage Rates—The average common labor rate for construction is 41.05c. per hour, compared with 41.22c. in April and 53.94c. for May, 1931. The average skilled rate is 94.9c. per hour, unchanged from the April rate, which is revised from 93.5c. The May, 1931, skilled rate was $1.36 per hour.

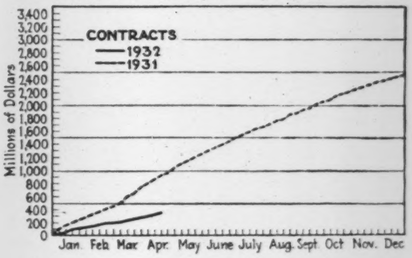
Capital and Contracts

New capital issued in the week ended April 30 amounted to $8,000,000, evenly divided between private and public bonds. In the week ended April 23 a total of $44,000,000 included $9,000,000 public, compared with $35,000,000 private issues. The weekly average for April is $18,600,000, compared with $30,000,000 in March and $45,250,000 for April, 1931. Cumulatively, the total, Jan. 1 to April 30, inclusive, is $465,000,000, against $1,024,000,000 in the corresponding period of 1931. This week's contracts with comparisons follow:

(In Thousands of Dollars)

Engineering Construction	Week of May 5, 1932	Average Week April, 1932	Average Week May, 1931
Federal government	$4,632	$2,790	$2,585
State and municipal	11,473	13,236	27,924
Total public	$16.105	$16.026	$30.509
Total private	6.553	7.874	23.949
Grand total	$22.658	$23.901	$54.458
Cumulative, all classes, Jan. 1 to May 5:			
1932			$371,897
1931			1,039,358





CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Advances since last month are indicated by **heavy type,** declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structural Iron Workers	Masons' Laborers	Common Laborers
Atlanta	$0.60	$0.40	$0.50	....	$0.50	$0.37½	$0.10@.30
Baltimore	*1.00*	.80@.90	1.00@1.25	$0.65	1.00@1.25	.65	.30
Birmingham	.75@.87½	.60	.75	....	.75	.35	.15@.25
Boston	1.00@1.50	1.00@1.17½	1.00@1.37½	*1.07½*	1.00@1.37½	*.70*	.50@.70
Cincinnati	.90	.50	1.00	1.00	1.00	.70	.25@.45
Chicago	1.37½	1.31¼	1.31¼	1.31¼	1.35	.82½	.50@.82½
Cleveland	.90	.87½	.90@1.00	*1.00*	.90@1.00	.56¼	.30@.40
Dallas	1.00	.75	.87½	.87½	.87½	*30.@.40*	.20@.25
Denver	1.00@1.12½	.75@.87½	.75@.87½	....	.75@.87½	.50	.31¼@.50
Detroit	1.00	.70	1.00	1.00@1.10	1.00	.50	.30@.50
Kansas City	1.30	1.12½	1.12½	1.06	1.12½	.80	.25@.70
Los Angeles	.62½	.50	.75	.75	.75	.50	.40
Minneapolis	1.10	.75	.80	....	.90	.70	.45
New Orleans	.60@.80	.40@.50	.80@1.12½	.90	.80@1.12½	.50	.15@.20
New York	1.50	1.25	*1.50*	*1.50*	*1.50*	.81¼	.50@.81¼
Philadelphia	1.00	.80	1.02½	1.00	1.02½	.40	.30@.40
Pittsburgh	.60@1.50	.60@1.25	.60@1.37½	....	.60@1.37½	.50	.40
St. Louis	1.47	1.25	1.35@1.47	1.25	1.47	1.00	.35@.70
San Francisco	*1.10*	*.90*	*.90*	*.90*	*1.10*	*.70*	.40@.68¾
Seattle	.75	.50	*1.00*	*.90*	*1.10*	*.66*	.40@.59⅜
Average	1.01	.81¾	1.01½	*1.01¾*	*1.02*	.59	*.4105*
Montreal	1.12½	.75	.70	.70	.75@1.00	.40	.25@.40

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered
Atlanta	$1.35	$1.95
Baltimore	.....	1.87
Birmingham	1.83	1.93
Boston	.....	1.86
Chicago	.....	*1.35*
Cincinnati	1.52	1.64
Cleveland	1.25	1.50
Dallas	1.83	1.98
Denver	.....	1.95
Detroit	1.47	1.85
Jersey City	1.53	*1.63*
Kansas City	.....	*1.50*
Los Angeles	.....	1.95
Minneapolis	1.83	1.95
Montreal	.....	1.95
New Orleans	1.86	1.96
New York	1.34	*1.44*
Philadelphia	.....	1.95
Pittsburgh	.....	1.78
St. Louis	1.47	1.85
San Francisco	.....	1.95
Seattle	.....	1.95

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich	$1.20	Mason City, Ia	$1.10
Buffington, Ind	1.10	Norfolk, Va	1.61
Dallas, Tex	1.74	Northampton, Pa	1.21
Hannibal, Mo	1.10	North Birmingham, Ala	1.31
Hudson, N. Y	1.21	Richard City, Tenn	1.31
Independence, Kan	1.10	Steelton, Minn	1.61
Ironton, Ohio	1.06	Universal, Pa	1.21
Iola, Kan	1.10	Waco, Tex	1.65
La Salle, Ill	1.10	Wyandotte, Mich	1.20
Limedale, Ind	1.10		

SAND AND GRAVEL — Per ton, carload lots; gravel, sizes ¾-in. or 1½-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.35	....	2.08
Birmingham, per cu.yd	....	2.75	....	2.25
Boston	....	1.58	....	1.10
Chicago, per cu.yd	....	*1.50*	....	*1.50*
Cincinnati	1.30	1.60	1.05	1.35
Cleveland	....	2.00	....	2.00
Dallas, per cu.yd	1.00	1.50	1.00	1.50
Denver, per cu.yd	....	1.80	....	1.35
Detroit	.77	1.65	.72	1.50
Kansas City	.75	1.25	.60	1.10
Los Angeles	1.35	*1.60*	.85	1.00
Minneapolis, per cu.yd	....	2.40	....	1.00
Montreal	....	1.50	....	1.25
New Orleans	1.50	2.50†	1.20	2.00†
New York, per cu.yd	1.60*	2.69	1.00*	1.69
Philadelphia	....	2.78	....	1.98
Pittsburgh	....	1.55	....	1.75
St. Louis	1.17	1.65	.80	1.35
San Francisco	....	1.75	....	1.75
Seattle, per cu.yd	....	1.85	....	1.85

*50,000 cu.yds. †Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	....	*Slag used*
Boston	....	1.88
Chicago, per cu.yd, 2,500 lb	....	*1.50*
Cincinnati	1.65	1.85
Cleveland	....	*2.00*
Dallas, per cu.yd., 2,500 lb	1.90	2.90
Denver, granite, per cu.yd., 2,700 lb	....	2.50
Detroit	1.10	1.95
Kansas City	1.50	2.00
Los Angeles	1.35	*1.60*
Minneapolis, per cu.yd., 2,600 lb	....	2.40
Montreal	....	1.15
New York, per cu.yd., 2,800@3,000 lb	1.55*	2.69
Philadelphia	....	2.73
Pittsburgh	....	3.00
St. Louis	1.15	1.65
San Francisco, trap rock	....	1.65
Seattle, per cu.yd., 3,000 lb	....	3.00

*50,000 cu.yds.

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.10	1.10	2.25	.70
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.10	1.10	1.10	1.00
Youngstown District	1.25	1.35	2.00	1.25

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Birmingham (5x8x12)	$0.084	Kansas City	$0.18
Boston	.18	Minneapolis	.10
Brooklyn and Queens	.12	New Orleans	.18
Chicago	.....	Philadelphia	.15
Cleveland	.165	Pittsburgh	.15
Denver	.15	St. Louis	.14
Detroit	.12		

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered:

Atlanta	$7.75	Detroit	5.90
Birmingham	5.00	Los Angeles	7.60
Boston	7.50	New Orleans	6.30
Cincinnati	7.10	New York	7.00
Dallas	6.00	St. Louis	6.65

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.105	.14	.20	.23	.30
Birmingham	.089	.122	.167	.219	.25
Boston	.08	.115	.145	.21	.325
Chicago	*.045*	*.063*	.09	.117	.13
Cincinnati	.06815	.09485	.129	.165	.184
Cleveland	.048	.066	.09	.117	.13
Dallas	*.084*	.121	.159	*.17*	.234
Denver	.0975	.135	.175	.2125	.25
Detroit	.08	.11	.145	.19	.215
Kansas City	.088	.11	.145	.19	.215
Los Angeles	.09425	.134	.188	.2325	.3115
Minneapolis	.075	.09395	.1232	.15025	.2103
New Orleans	.085	.115	.16	.225	.255
New York	.075	.125	.14	....	....
Perth Amboy	....	....	....	.2388*	.2956*
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.0458	.065	.088	.113	.126
St. Louis	.068	.098	.12	.16	.20
San Francisco	.0765	.105	.1765	....	....
Seattle	.085	.115	.18	....	....

*At plant.

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Face		Paving F.o.b.
	F.o.b.	Delivered	F.o.b.	Delivered	3x8½x4-in.
Atlanta	$8.50	$14.00	$15.50	$20.50	$32.00
Baltimore	.....	12.50	.....	25.00	40.00
Birmingham	10.00	12.50	20.50	23.00	27.00
Boston	.....	13.00*	.....	27.50	47.00
Chicago	.....	*9.00*	.....	32.50	32.00
Cincinnati	13.50	16.00	.....	24.00	36.50
Cleveland	.....	13.00	.....	24.50	33.00
Dallas	.....	*12.00*	.....	23.00	25.00
Denver	.....	9.50	.....	25.00	.....
Detroit	14.20	15.00	.....	25.00	25.00
Kansas City	12.00	14.00	23.00	25.00	35.00
Los Angeles	.....	8.50	.....	*24.00*	.....
Minneapolis	.....	8.50	.....	*28.00*	.....
Montreal	.....	16.00	.....	.....	.....
New Orleans	10.50	12.50	.....	25.00	40.00
New York	10.00	11.50	28.00	30.00	45.00
Philadelphia	.....	16.00	.....	.....	40.00
Pittsburgh	.....	12.00	.....	22.00	25.00
St. Louis	.....	*12.00*	.....	22.00	32.00
San Francisco	.....	14.00	.....	.....	45.00†
Seattle	.....	14.00	.....	.....	48.50

*Merchantable, $14.00. †2½x8½x4-in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net, delivered:

	Hydrated				Common Lump.	
	Finishing		Common			
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	.....	$2.50
Baltimore	.....	*20.00*	.....	*13.00*	.....	2.25
Birmingham	.....	*21.00*	.....	*12.00*	.....	*1.65*
Boston	.....	21.00	.....	14.00	.....	*2.25*
Chicago	.....	13.00	.....	12.00	.....	1.25
Cincinnati	11.00	12.00	9.40	10.40	.....	....
Cleveland	.....	12.00	.....	10.00	.....	2.50
Dallas	.....	20.00	.....	.....	.....	2.50
Denver	.....	30.00	.....	23.75	.....	3.00*
Detroit	.....	13.00	.....	12.00	.....	1.55
Kansas City	.....	19.00	.....	18.00	.....	2.50
Los Angeles	.....	26.00	.....	18.00	.....	2.00
Minneapolis	.....	21.00	.....	19.00	.....	1.70
Montreal	.....	18.00	.....	8.00	.....	....
New Orleans	14.75	22.00	11.58	13.00	$1.66	1.95
New York	.....	16.00	.....	13.00	.....	3.15*
Philadelphia	.....	18.00	.....	14.50	.....	14.00†
Pittsburgh	.....	15.00	.....	14.00	.....	2.75
St. Louis	17.00	18.00	15.00	16.00	11.50†	12.50†
San Francisco	17.50	19.00	17.50	19.00	.....	1.59
Seattle	.....	35.00	.....	24.00	.....	2.80

*Per 280-lb. bbl. (net.) †Per ton.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:
New York: Rustic buff, $1.37; Standard gray, $1.47; Standard, $1.57; Selected gray, $1.57; Selected buff, $1.67.
Boston: Rustic buff, $1.43; Standard, $1.56; Selected buff, $1.70.
Pittsburgh: Rustic buff, $1.56; Standard, $1.76; Selected buff, $1.86.
Atlanta: Standard, $1.26.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square;

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.	Kansas City	$2.75 per sq.yd
Baltimore	3.00 per sq.yd.	Minneapolis, 4½ in.	2.80 per sq.yd
Birmingham	76.25 per M.	Montreal	104.75 per M.
Boston	105.00 per M.	New Orleans	2.80 per sq.yd
Chicago, 5 in.	3.80 per sq.yd.	New York, 5 in.	120.00 per M.
Cincinnati	110.00 per M.	Philadelphia	105.00 per M.
Cleveland	95.00 per M.	St. Louis, 5 in.	115.00 per M.
Detroit, 5 in.	3.00 per sq.yd.		

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.25
Chicago	3½	12	1.90
Kansas City	3¼	16	2.00
Minneapolis	3¼	16	2.50
Montreal	3½	16	2.63
New Orleans	3¼	16	2.30
New York	3¼	14	1.90
St. Louis	3¼	16	2.10

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	Detroit	$0.45
Birmingham	.50	New York	.80
Boston	.75	Pittsburgh	.80
Dallas	.60	St. Louis	.75

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$18.60	$14.60
Baltimore (f.o.b. refinery)	16.00	12.00
Birmingham	.....	*11.00*
Boston	21.00	17.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	......	*8.00*
Cleveland	18.25	14.50
Dallas	19.50	......
Denver	27.50	......
Detroit	16.68	12.43
Kansas City (f.o.b. refinery)	18.00	13.00
Los Angeles (f.o.b. refinery)	18.00	12.00
Maurer, N. J. (Bermudez)	......	25.00
Maurer, N. J. (Trinidad)	......	21.00
Minneapolis (f.o.b. Twin Cities)	23.30	16.30
Montreal	17.00	13.00
New Orleans (f.o.b. refinery)	16.00	12.00
New York (f.o.b. refinery)	16.00	12.00
Philadelphia	16.00	12.00
Pittsburgh	25.00	16.00
St. Louis (f.o.b. refinery)	12.00	8.00
San Francisco (f.o.b. refinery)	*14.00*	*8.00*
Seattle	21.40	18.00

LIQUID ASPHALT—Residual, prices f.o.b., in tank cars, 8,000 gal. minimum, 45% asphalt, per gal.:

Birmingham	$.06
Boston	.055
Cincinnati	.05
Dallas	.05
New York	.05
St. Louis	.055*

*Emulsified, 12@13c., applied.

Iron and Steel

PIG IRON—Furnace, No. 2 foundry, per gross ton:

	Current	Mo. Ago	Yr. Ago
Birmingham	$11.00	$11.00	$12.00
Buffalo	16.00	14.00@ 15.00	17.50

	Pittsburgh	Chicago	Birmingham	Cleveland
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.50	$1.70	$1.75	$1.78
CONCRETE REINFORCING BARS, ¾ in., billet, per 100 lb., carload lots	1.50	1.65	1.75	1.50
SHEETS, per 100 lb., carload lots:				
Hot-rolled No. 10	1.55	1.65	1.70	.....
Hot-rolled annealed No. 24	2.20	2.30	2.35	.....
Galvanized No. 24	2.85	2.95	3.00	.....
TERNE PLATES, per package, I.C., 8-lb. coating, 20x28 in.	9.50	.....	.....	.....
RIVETS, per 100 lb., ½ in., structural, carload lots	2.25	2.35	2.35	2.25
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....	....
WIRE NAILS, per 100 lb., base, carload lots	1.95	2.00	2.10	1.95
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	9.75	6.75	7.00	7.00

TRIANGLE MESH—Plain, per 100 sq.ft., 4 in. x 4 in., in carload lots:

Style Number	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	22	$0.94	$0.96
049	28	1.19	1.22
068	35	1.45	1.49
093	45	1.87	1.91
126	57	2.31	2.37
153	68	2.75	2.82
180	78	3.16	3.24

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½%
Galvanized steel rigging and guy rope	12½%
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½%

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd. painted, f.o.b., in carload lots, 2.2 lb. per sq.yd.:

Atlanta	$20.00	Kansas City	$17.00
Birmingham	14.50	New Orleans	20.50
Boston	16.00	New York	13.50
Chicago	10.60	St. Louis	17.00
Cincinnati	11.00	San Francisco	17.00
Dallas	16.50		

STEEL FREIGHT RATES—The following freight rates per 100 lb., effective Dec. 3, 1931, apply on finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.:

Atlanta	$0.60*	Detroit	$0.285†
Baltimore	.29†	Kansas City	.59†
Birmingham	.60*	New Orleans	.69*
Boston	.42†	New York	.35*
Buffalo	.255†	Pacific Coast (all rail)	1.17‡
Chicago	.36†	Philadelphia	.31†
Cincinnati	.285†	St. Louis	.41†
Cleveland	.205†	St. Paul	.60†
Denver	1.17‡		

*36,000 lb. †40,000 lb. ‡60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Standard rails have been $43.00 per gross ton since Sept., 1922, at which time the price was $40.00; other rails, per gross ton, f.o.b., as follows:

	Pittsburgh	Birmingham	Chicago
Light rails	$34.00	$34.00	$34.00
Re-rolled rails	*24.00*	.....	*27.00*

RAILWAY TIES—Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Pine, untreated	$0.95	....
	Pine, creosoted	1.45	
New York	Long-leaf sap pine, untreated	.90	$1.10
	Dense yellow pine, untreated	*.65*	*.85*
Birmingham	White oak, untreated	.90	1.05
	White oak, creosoted	1.45	1.55
	Southern pine, untreated	.45	*.90*
	Southern pine, creosoted	1.05	1.40
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
St. Louis	White oak, untreated	*.75*	*1.25*
	Red oak, untreated	*.70*	*1.15*
	Red oak, creosoted	*1.05*	*1.70*
	Sap pine or cypress, untreated	*.60*	*1.00*
San Francisco	Douglas fir, green, untreated	*.45*	*.65*
	Douglas fir, empty cell, creosoted	*1.19*	*1.62*
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f.o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Standard spikes	$2.60	*$2.60*	$2.60
Track bolts	3.50	*3.50*	*3.50*
Angle bars	2.75	*2.75*	2.75
Tie plates	1.85	*1.85*	*1.85*

Pipe

WROUGHT STEEL PIPE — Discounts from standard lists for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Boston	55.5%	42.25%	51.35%	40.1%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
New York	56.14%	43.6%	52.72%	40.18%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	51%	38%	48%	35%

CAST-IRON PIPE — Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots:

	4-In.	6-In. and Over
Boston	$39.00	$36.00
Birmingham	35.00	32.00
Burlington	35.00	32.00
Chicago	*39.40*	*36.40*
New York	*31.20*	*28.20*
Pittsburgh	*39.50*	*36.50*
St. Louis	*39.80*	*36.80*
San Francisco	*39.00*	*36.00*

Gas pipe and Class A, $3.00 per ton extra.

Current Prices of Construction Materials

Pipe—Continued

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.125	$0.21	$0.385	.....	$1.40.	.....	......
Baltimore	.10	.30	.58	......	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.18	.28	.55	1.35	2.27	4.75	5.90
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.108	.21	.324	1.05	1.755	3.528	5.4325
Cleveland	.1125	.175	.3375	.825	1.485	4.824	7.38
Dallas	.23	.325	.586	1.106	1.95	3.68	5.00
Denver	.161	.23	.414	.816	1.44	.....	......
Detroit	.135	.21	.405	1.05	2.25	4.10	.....
Kansas City	.21	.335	.52	1.00	1.90	3.60	......
Los Angeles	.2175	.2825	.5085	1.1865	2.034	3.69	......
Minneapolis	.18	.23	.46	1.20	1.85	3.20	4.26
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.18	.30	.54	1.02	1.95	.....	......
New York	.17	.265	.52	1.30	2.34	4.47	6.86
Philadelphia	.0945	.147	.297	.80	1.44	2.304	3.28
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.147	.235	.423	1.05	1.80	3.20	4.40
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.22	.30	.54	1.26	2.16	2.50	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Birmingham	$50.00	New York	$40.00
Boston	45.00	Pittsburgh	80.00
Chicago	40.00	St. Louis	50.00
Dallas	65.00	San Francisco	67.50
Los Angeles	60.00	Seattle	60.00
New Orleans	40.00		

Miscellaneous

LINSEED OIL—Raw, in 4-bbl. lots, per lb., f.o.b.:

Atlanta	$0.065	Kansas City	$0.075
Birmingham	.08	Minneapolis	.078
Boston	.0775	New York	.074
Dallas	.073		

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Birmingham	$12.50	Kansas City	$12.25
Boston	13.00	New York	12.00
Dallas	13.00		

Note: Both white and red lead, dry, same prices as foregoing; red in oil, $1.50 higher.

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75
Calcium chloride, 77-80%, flaked, in 400-lb. drums, f.o.b. works, per ton	21.00
Chlorine, cylinders, per lb.	.04
Silicate of soda, in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in bags, per 100 lb.	1.15@1.17½
Sulphate of aluminum, in bags, per 100 lb.	1.25
Sulphate of copper, in bbl., per 100 lb.	2.75

MANILA ROPE—The number of feet per pound for the various sizes is as follows: *¾-in.*, 6-ft., 1-in.; *⅞-in.*, 4-ft., 5-in.; *1-in.*, 3-ft., 8-in.; *1¼-in.*, 2-ft., 5-in.; *1½*-in., 1-ft., 8-in. Following prices are per lb. for ¾-in. and larger, delivered in 1,200 ft. coils:

Atlanta	*$0.172*	Kansas City	$0.23
Baltimore	.225	Los Angeles	*1725*
Birmingham	*.20*	Minneapolis	*.175*
Boston	.20	Montreal	*.175*
Chicago	.175	New Orleans	.19
Cincinnati	.21	New York	.17
Cleveland	.21	Philadelphia	.21
Dallas	.25	St. Louis	*.155*
Denver	.20	San Francisco	*.155*
Detroit	.18	Seattle	.175

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point $2.05

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.52

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Boston	$6.75	$6.50	$2.65
Dallas	5.25	4.50	2.25
New Orleans	.....	6.50	2.50
New York	6.50	6.25	2.50

*Slate finish, sufficient to cover 100 sq.ft.
†4 in 1, hexagonal shape, with Underwriters' label.
‡Slate surfaced, in rolls weighing 85 to 90 lb.

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch per Ton
Boston	$2.50	$2.50	*$0.35	$30.00
Dallas	3.25	3.50	.....	42.00
New Orleans	.....	.....	.....	22.50
New York	2.40	2.40	.34½	28.00

*In 350 lb. barrels.

WINDOW GLASS—Discounts from latest jobbers' list, dated Sept. 15, 192 for sizes above first three brackets:

	Single Thickness		Double Thickness	
	A Quality	B Quality	A Quality	B Quality
Birmingham	89%	91%	89%	91%
Boston	85%	90%	86%	90%
Dallas	85%	85%	87.5%	89.5%
Kansas City	80%	80%	80%	80%
New York	87%	89%	87%	89%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin			Gelatin	
	40%	60%		40%	60%
Atlanta	$0.215	$0.2375	Los Angeles	$0.1725	$0.1925
Baltimore	.215	.2375	Minneapolis	.18	.195
Birmingham	.13	.1525	Montreal	.17	.195
Boston	.225	.25	New Orleans	.195	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.28	.30	St. Louis	.1975	.2175
Denver	.19	.2125	San Francisco	.155	.18
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

Lumber

LUMBER—Per M. ft., b.m., No. 1 Common, rough, in carload lots:

PINE

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†	
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.
Atlanta	$14.00	.....	$15.00	.....	$35.00	$50.00
Baltimore	.....	.....	.....	.....	.....	72.00
Birmingham	.....	$15.00	.....	$15.00	18.00	33.00
Boston	.....	40.00	.....	42.00	.....	50.00
Chicago	.....	.....	.....	.....	.....	62.50
Cincinnati	.....	28.00	.....	28.00	.....	35.00
Cleveland	.....	.....	.....	.....	.....	52.00
Dallas	.....	32.50	.....	32.50	.....	47.50
Detroit	.....	29.00	.....	30.00	32.00	63.00
Kansas City	21.00	.....	23.00	.....	28.00	55.00
Los Angeles	.....	.....	.....	.....	.....	.....
Minneapolis	.....	31.00	.....	31.00	.....	36.00
Montreal	.....	.....	.....	.....	.....	40.00
New Orleans	.....	15.50	.....	16.50	.....	52.00
New York	.....	31.00	.....	32.00	43.00	63.00
Philadelphia	.....	.....	.....	.....	.....	55.00
Pittsburgh	.....	.....	.....	.....	.....	60.00
St. Louis	25.00	31.00	26.00	32.00	27.50	36.00

FIR

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†	
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.
Baltimore	.....	.....	.....	.....	.....	$48.00
Boston	.....	$38.00	.....	$40.00	.....	43.00
Chicago	.....	.....	.....	.....	.....	44.52
Cincinnati	.....	.....	.....	.....	.....	42.50
Cleveland	.....	.....	.....	.....	.....	52.00
Dallas	$30.00	31.00	$29.00	30.00	$38.00	40.00
Denver	.....	.....	.....	.....	.....	49.00
Detroit	.....	.....	.....	.....	30.00	51.00
Kansas City	.....	.....	.....	.....	31.50	40.00
Los Angeles	39.00	41.50	39.00	41.50	43.00	45.50
Minneapolis	.....	31.00	.....	31.00	36.00	40.00
Montreal	.....	.....	.....	.....	.....	41.75
New Orleans	.....	20.00	.....	20.00	42.50	58.00
New York	.....	.....	.....	.....	.....	28.00
Philadelphia	.....	.....	.....	.....	.....	40.00
Pittsburgh	.....	.....	.....	.....	.....	58.00
St. Louis	27.50	32.50	29.50	35.00	33.50	39.50
San Francisco	.....	.....	.....	.....	.....	35.00
Seattle	.....	.....	.....	.....	.....	15.00

*Form lumber, 16 ft. lengths. †Planks, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1¾ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.110	$0.165
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.45	.215
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.17	.235
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.205	.345
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2225	.295
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.285	.395
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.325	.435